IDAHO STATE FORESTRY CONTEST

Instruction Manual for Teachers and Students

Sponsored by:

Bonner Soil & Water Conservation District
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and

Idaho Department of Lands
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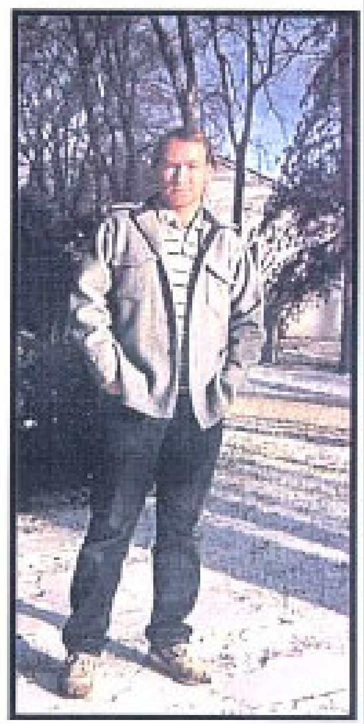
IDAHO STATE FORESTRY CONTEST

DEDICATION
TO
DAVID RITZ

IN DEDICATION TO DAVID RITZ

David Ritz was eleven years old when his father took him on a backpacking trip in the Bob Marshall Wilderness area of Montana. Roughing it, backpacking through this magnificent scenery, fascinated by the animal and plant life, David found a new world of peace and tranquillity.



DAVID RITZ

Upon returning home to Franklin, Ohio, David told his father of his determination to return every year if at all possible. His father agreed and made contact for David to be employed by backpackers in Missoula. He continued this summer employment all through his teen years and during his college years while attending the School of Forestry at the University to Montana. The U.S. Forestry Department became his employer, assigning him to Montana and later transferring him to Bonners Ferry, Idaho.

David once said, "There is no way I can express to you the joy of life I experienced in the *great outdoors* as a packer and Forester! Try it, you'll love it!"

The Bonner Soil Conservation District and the Idaho Department of Lands are honored to dedicate this manual to the late David Ritz as an inspiration to the foresters of the future.

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INTRODUCTION

HISTORY

Welcome to the Idaho State Forestry Contest! The inaugural Idaho State Forestry Contest was held in May 1983 at Delay Farms near Careywood, Idaho. Jointly sponsored by the Idaho Department of Lands, the Bonner Soil and Water Conservation District, and the Panhandle Lakes Resource Conservation and Development (Project 16-6001-988-003), the contest was intended to encourage young people to learn about Idaho's vast forest resource. There was no question that the contest would become an annual event based upon its initial success.

CONTEST OBJECTIVES

The principal objective of the contest is to introduce young people to some of the basic skills that are used in the forestry profession. It is hoped that by learning these skills, the individual will possess a higher degree of understanding and knowledge about our forests.

A secondary objective is to provide an opportunity for interaction between students and professional foresters and conservationists. The concept of natural resource professionals meeting and teaching students allows a unique opportunity for a young person to explore career opportunities in the field of forestry.

HOW THE CONTEST WORKS

The Idaho State Forestry Contest is open to junior high and high school age students. The contest is not limited to school sponsored teams: 4-H, Boy Scouts, Girl Scouts, FFA and other youth organizations are actively encouraged to participate.

Teams, consisting of four people each, compete in eight categories. There are ten categories, of which eight are used each year and two are randomly left out. The contestants do not know in advance which two categories will not be used in a given year. The ten categories are: 1) log scaling; 2) timber cruising; 3) tree and plant identification and tree planting; 4) map reading; 5) compass and pacing; 6) tool identification; 7) soils and water quality; 8) tree health; 9) silviculture; and 10) noxious weeds. Students compete in either the Junior or Senior Division. (The Junior Division is 8th grade and below, and the Senior Division is 9th grade and above.) Prizes are awarded in both individual and team categories.

TIE BREAKER

In the event that two teams or individuals have identical scores, a tie-breaking system has been established as follows:

The team with the most points on the Plant Identification sections will be declared the winner. If the Plant Identifacation section is also a tie or is not a tested section that year, the team with the most points for the Log Scaling section will be declared the winner. In the event they are also tied or that section is also not tested, we will go to Timber Cruising, Map Reading, Compass and Pacing, Tool Identification, Soils and Water Quality, Tree Health, and Silviculture, in that order.

PURPOSE OF THIS MANUAL

The purpose of the manual is to provide some brief instruction on each of the ten categories tested in the forestry contest.

The practical forestry skills that re required to compete in the contest are by no means common knowledge to teachers and students. Rather, they involve specific knowledge of forestry and forest measurements.

Without a doubt, the best means for a student to acquire the necessary forestry skills is to spend several hours with a forester. A few hours of "hands-on" instruction with someone who knows the "tricks of the trade" cannot be overemphasized. Section 11 of this manual provides information on who to contact to arrange for a forester to work with your team.

Best of luck at the upcoming

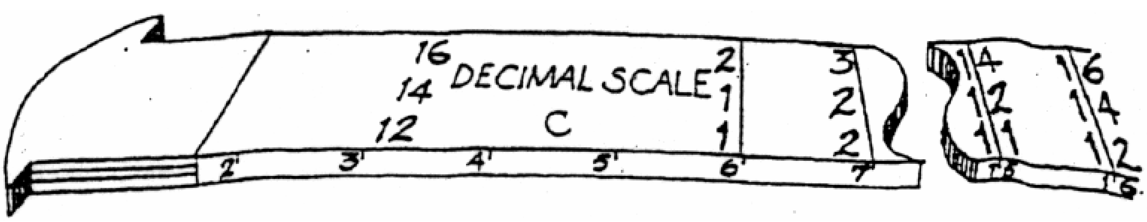
IDAHO STATE FORESTRY CONTEST!!

LOG SCALING

Log scaling is the measurement of the ***board foot volume*** of a log. ***One (1) board foot*** is equal to a 12-inch by 12-inch board that is one (1) inch thick. Idaho uses the ***Scribner Decimal C Log Rule*** that estimates the number of board feet that can be cut from a given log.

Two (2) measurements are needed to determine the board foot volume of a log. The length of a log is measured in feet and the diameter of the *small* end of the log is measured in inches.

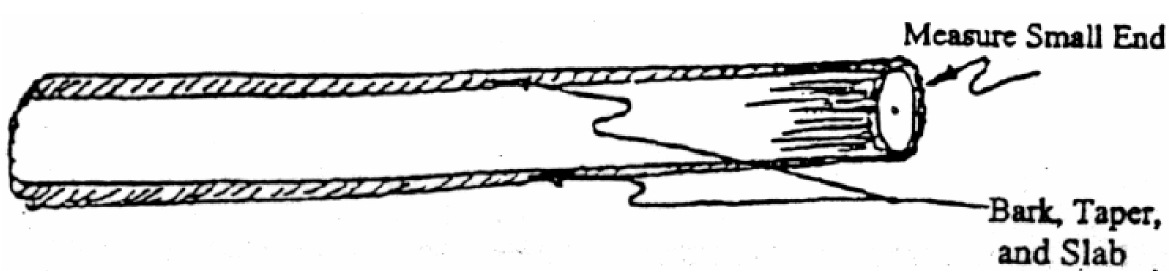
The principal tools needed to determine the board foot volume of a log are either a ***log scale stick***, or a ***log rule table*** used in conjunction with a measuring tape. A log scale stick simplifies scaling because it combines both a measuring stick and a table of log volumes. Divisions on the log scale stick are to the one-half inch, so no rounding is needed.



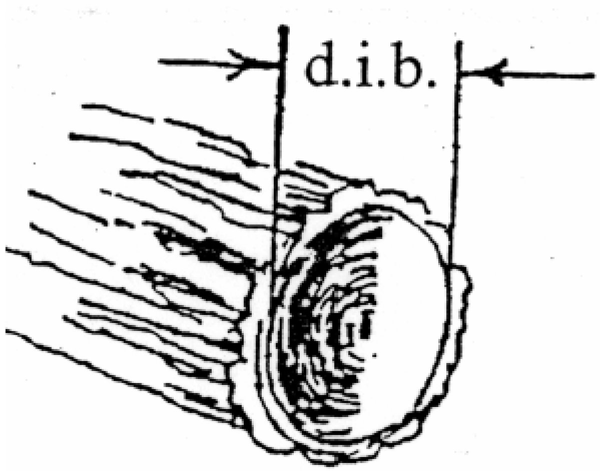
Several important guidelines must be considered in making these measurements:

MEASURING THE DIAMETER OF A LOG

→ Remember to measure the diameter of the *small* end of the log.

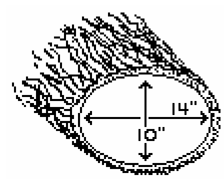


→The diameter of the log is always measured *inside* the bark. This measurement is called "***diameter inside of bark***" or ***d.i.b.***



→The ends of all logs are not circular. On oval-shaped logs, the diameter is determined by averaging the short measurement and long measurement, taken at 90 degrees from the short measurement. Both measurements are taken through the center of the log.

$$\frac{10+14}{2} = 12$$



→***Sawlogs*** (except for "***peelers***") are measured in even two (2) foot lengths up to a maximum scaling length of 20 feet. For longer lengths (22' to 40'), the logs are scaled either as two segments of equal length (e.g. 32' = 16' + 16') or as two unequal segments with the butt segment the longer by two feet (e.g. 26' = 12' top + 14' butt segments). The most common lengths are 8', 16', and 32' (although a log could be 10', 12', etc.). A 32' length log is scaled as two 16' segments.

→Extra inches are added to the length of a log for ***trim allowance***. In other words, a 16 foot log will not be exactly 16 feet long. For example, a 16 foot log may actually measure 16'6". Trim will vary according to sawmill specifications, but 6 inches per segment is standard.

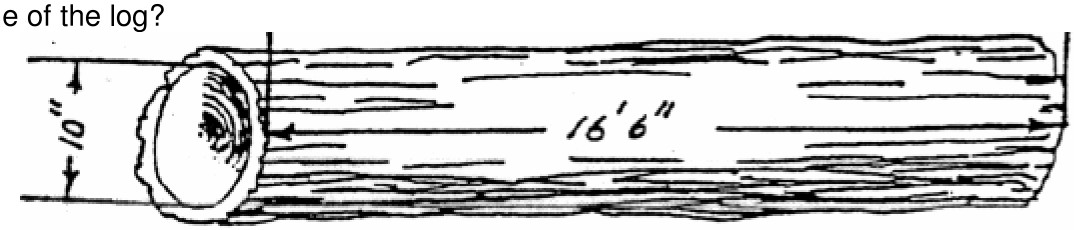
→To measure a log's diameter inside of bark, a log scale stick or simply a yard stick can be used to measure the d.i.b. at the small end of the log. The log length is usually measured using a logger's tape, but any measuring tape can be used. A logger's tape is faster and more convenient, however.

→After measuring d.i.b. (at the small end) and log length, refer to a ***Scribner Log Rule Table*** to calculate the board foot volume of the log. A Scribner Log Rule Table is illustrated in the following table:

Log Volumes by Scribner Decimal C Log Rule:

d.i.b.	8	10	12	14	16
inches	Board-foot volume in tens				
6	.5	1	1	1	2
7	1	1	2	2	3
8	1	2	2	2	3
9	2	3	3	3	4
10	3	3	3	4	6
11	3	4	4	5	7
12	4	5	6	7	8
13	5	6	7	8	10
14	6	7	9	10	11
15	7	9	11	12	14
16	8	10	12	14	16
17	9	1	14	16	18
18	11	13	16	19	21
19	12	15	18	21	24
20	14	17	21	24	28
21	15	19	23	27	30
22	17	21	25	29	33
23	19	23	28	33	38
24	21	25	30	35	40
25	23	29	34	40	46
26	25	31	37	44	50
27	27	34	41	48	55
28	29	36	44	51	58
29	31	38	46	53	61
30	33	41	49	57	66
31	36	44	53	62	71
32	37	46	55	54	74
33	39	49	59	69	78
34	40	50	60	70	80
35	44	55	66	77	88
36	46	58	69	81	92
37	51	64	77	90	103
38	54	67	80	93	107
39	56	70	84	98	112
40	60	75	90	105	120

EXAMPLE A - Suppose that you measure the diameter inside of bark of a log at the small end, and it is 10 inches. The log measures 16'6" in length. What is the board foot volume of the log?



Here is the procedure to follow, using the log rule table:

1) Starting at the top, look down the d.i.b. column until you find the proper diameter inside of bark. In this example, it would be 10.

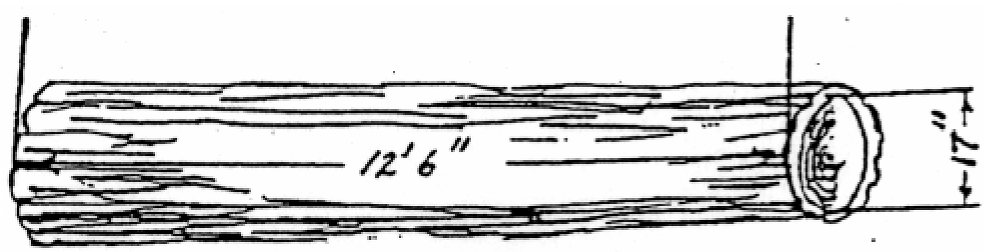
2) Next, follow across the top row of numbers until you find the proper log length. In this example, it would be 16'.

3) Now, go down from 16' to the number in the row corresponding to d.i.b. 10". The correct answer is **6**.

NOTE: The log table shown above is a ***Scribner Decimal C Table***. This means that all board foot volumes shown in the table should be multiplied by ten (10). Therefore, in the above example, 6 x 10 = 60 board feet in a log with a 10-inch d.i.b. and 16 feet in length. A simple way to calculate board foot volumes using the Decimal C log rule is to add a zero (0) to all of the board foot volumes given in the table.

EXAMPLE B

In this example, the d.i.b. measurement is 17 inches and the length is 12'6". What is the board foot volume of this log?



The correct answer from the table is 14. Remember, this number is the Decimal C volume, so it should be multiplied by 10 to give the actual board foot volume. Therefore, the correct answer is **140** board feet.

LOG DEFECT

The procedure described above for determining board foot volume assumes that the log is completely straight and the entire log can be used to manufacture lumber. In reality, logs are sometimes crooked or contain decay that makes a portion of the log unusable for lumber. This unusable portion is called ***defect***. The amount of defect must be measured and deducted from the knowledge and experience. It is not within the scope of the Forestry Contest to be able to accurately measure defect. Therefore, students should only be concerned with the ability to measure the volume of logs with no defect.

IDAHO STATE FORESTRY CONTEST

TIMBER CRUISING

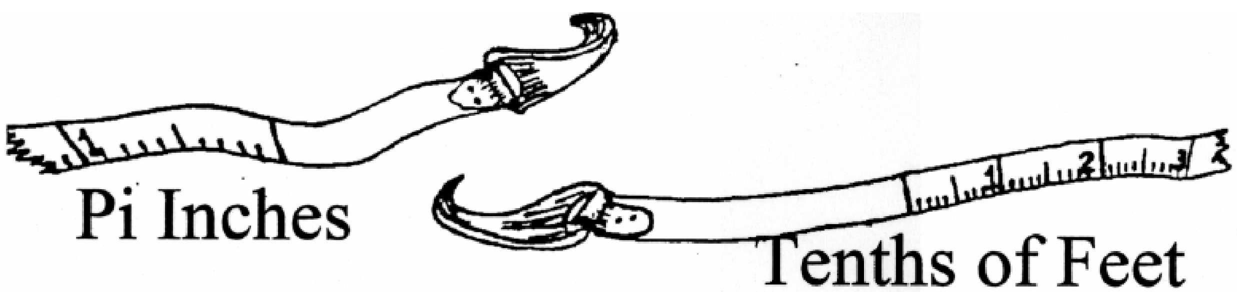
Timber cruising is the method that foresters use to determine the board foot volume of a standing tree and the amount of timber in a forested tract.

Two basic tree measurements are required in order to measure the board foot content of a standing tree. The ***diameter*** of the tree is measured at *4½ feet above the ground*. This is called the "diameter at breast height" and is commonly referred to as ***d.b.h.*** The ***height*** of a tree includes the *total height from ground level up to the top of the tree*. After determining the diameter at breast height and the total height of the tree, then a Board Foot Volume Table is used to compute the ***board foot volume***.

Let's take a closer look at the three steps involved in calculating the board foot volume of a tree:

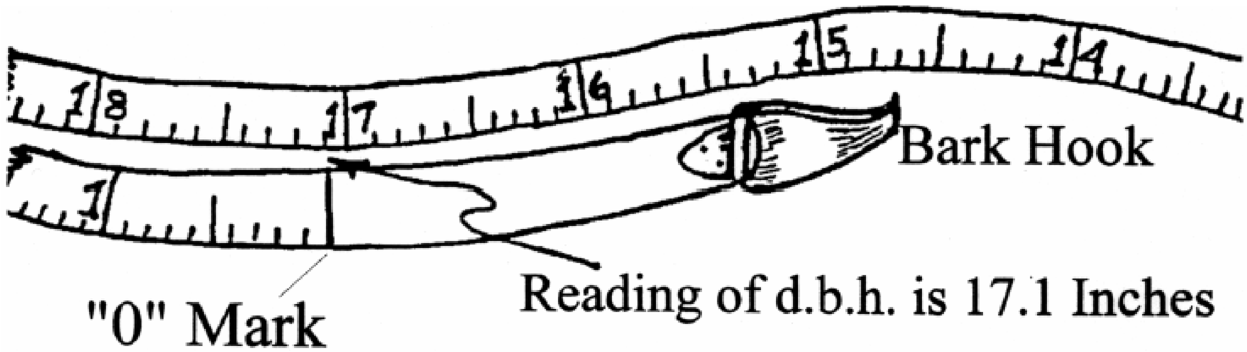
1. MEASURING TREE DIAMETER AT BREAST HEIGHT

A ***diameter tape*** is a commonly used tool for measuring d.b.h. A diameter tape differs from a normal measuring tape in that it usually has a hook on one end for attaching to the bark of a tree. Also, when you look at the tape, you will notice that one side is calibrated in feet and tenths of a foot while the other side is calibrated in "Diameter Equivalents of Circumference in Terms of Inches and Tenths of Inches."



Basically, this scale allows the user to measure the circumference of the tree and directly read the actual diameter. This eliminates the need for dividing the circumference measurement by Pi (3.1416) to calculate the diameter.

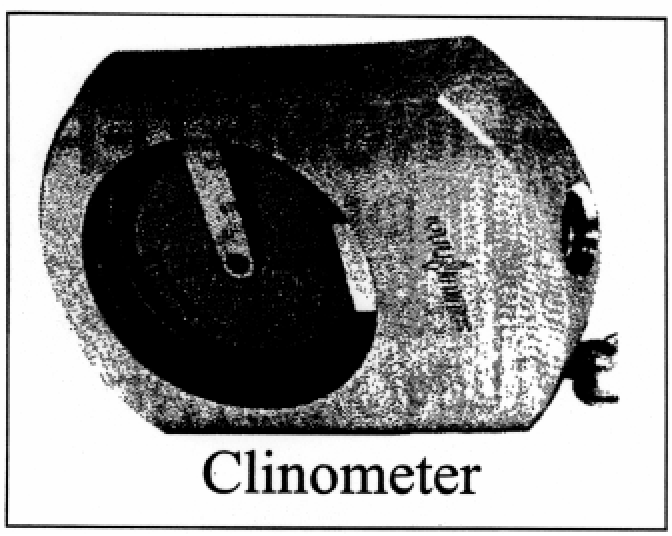
To measure the d.b.h., first measure 4½ feet up the tree from ground line (i.e. to “breast height”). Next, place the diameter tape’s hook into the bark at that point and extend the tape counterclockwise around the tree (making sure to keep the tape level). Finally, read the tree diameter where the tape crosses the “zero” line (located on the tape next to the hook), as illustrated below.



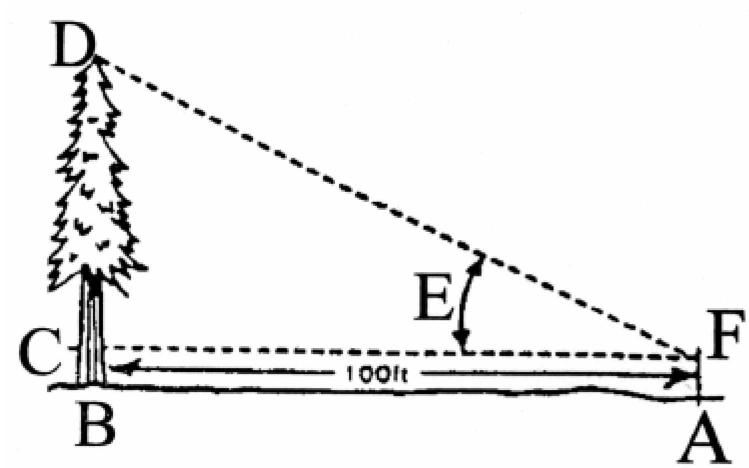
Diameter tape in use on a tree

2. MEASURING TOTAL TREE HEIGHT

A ***clinometer*** is the tool used to measure total tree height. With a little practice, you will be able to accurately determine the height of a tree. To use the clinometer, hold it up to your eye (with the lanyard ring below the lens opening). Keeping both eyes open, simultaneously look through the lens and alongside the clinometer’s housing to the target. By an optical illusion, the horizontal sighting line will appear to project outside the clinometer’s housing. Place the projected sighting line on your target and read the adjacent scale.



Example of Clinometer Use:



The task is to measure the height of a tree on level ground using the percent (%) scale of the clinometer. 100 feet is the most convenient baseline distance if you are using the percent scale on the clinometer. Back away from the tree 100 feet (from **C** to **F** on the diagram below). Sight the top of the tree (**D**) and read the percent (%) scale. This reading represents the height (also the distance and % slope) of the tree from eye level (0% slope) to the top of the tree (**C** to **D**). Now, sight on the base of the tree and read the percent scale again. This reading represents the distance (or height or % slope) from eye level to the base of the tree (**B** to **C**). Add this reading to the first reading you took. This will give you the total tree height (i.e. the distance from **B** to **D**).

If you are measuring a tree in dense underbrush where it is difficult or impossible to see the top or base of the tree at 100 feet, you would want to use the degree of slope scale (the other scale on the clinometer). To measure tree height using the degree of slope scale, you will use the same procedure described in the example above, except that you will stand only 66 feet away from the tree (instead of 100 ft.) and you will read the degree of slope scale on the clinometer (instead of the percent scale).

Contest Tip #1: Rounding Tree Heights

Tree heights are listed in 10-foot increments in the volume table

If a tree measurement ends up on a 5 or less, you should round down. With 6 feet or more, you should round up. For example, with a tree measuring from 66 to 75 feet tall, you would use the 70 foot tree height line. For a tree measuring between 86 to 95 feet tall, use 90 feet.

3. DETERMINING BOARD FOOT VOLUME

A volume table gives the number of board feet in a tree. This is an estimate of the amount of lumber that can be cut from an individual tree. Here is an example of the board foot volume table that will be used in the forestry contest:

Scribner Board Foot Volume Table								
d.b.h. (inches)	TOTAL TREE HEIGHT							
	50	60	70	80	90	100	110	120
12	30	50	70	90	100	120	140	160
14	50	70	100	130	160	180	200	220
16		100	140	170	200	240	260	300
18			170	220	260	290	330	370
20			210	260	310	360	400	440
22				310	370	420	470	520
24					430	490	540	610
26					490	550	630	690
28						640	710	780
30						710	790	880

To use the table, look down the d.b.h. column (on the left side) to find the d.b.h. (to the nearest 2 inches) of the tree you measured. Then look across the tree height line to find the height (to the nearest ten feet) of the tree you measured. Look down that column – the point where it intersects with the d.b.h. row is the board foot volume of your tree.

Example:
A tree has a d.b.h. of 20 inches and a total height of 100. Read down the d.b.h. column to "20" and then read across the tree height line to "100." This tree has a board foot volume of 360 board feet.

How many board feet would be contained in a tree that measures 14 inches d.b.h. and is 70 feet tall?*

Contest Tip #2: Rounding Diameters

D.B.H. is given in 2-inch increments in the volume table

The standard practice for rounding diameters is as follows: A tree in the 12-inch diameter class will be between11.1 inches and 13.0 inches in diameter. A 14-inch diameter class tree will be between 13.1 inches and 15.0 inches (and so on).

TREE AND PLANT IDENTIFICATION

The most basic skill that a forester must possess is the ability to recognize the trees and plants in an area. After a little practice, tree and plant identification becomes second nature: A quick glimpse of a tree's bark or a plant's leaf is often all that is needed to correctly identify the specimen.

The best way for a novice to learn the native tree and plant species is to spend some time with a forester or other knowledgeable person. Tree and plant identification is a skill that is difficult to learn out of a book.

If no one is available to teach you how to recognize trees and plants, then perhaps you could hike a nature trail that has plant species identified with labels. Many state parks and recreation areas have excellent nature trails.

NOTE: It is important to use the most widely accepted common name for a specimen. There is often more than one name used locally for a single type of tree or shrub. For example, in some areas Lodgepole pine may be referred to as jack pine, black pine or red pine. Ponderosa pine is sometimes called bull pine or yellow pine. Douglas-fir may be called red fir and grand fir may be called white fir. With all these multiple names being used in different areas, it is important to minimize confusion by learning and using the scientific names (shown below, in italics) as well as the common names that are most accepted by professional foresters.

The trees and plants you will need to be able to identify for the contest include:

CONIFERS

Douglas-fir (*Tseudotsuga menziesii*)
Western larch (*Larix occidentalis*)
Western white pine (*Pinus monticola*)
Ponderosa pine (*Pinus ponderosa*)
Lodgepole pine (*Pinus contorta*)
Western hemlock (*Tsuga heterophylla*)
Grand fir (*Abies grandis*)
Engelmann spruce (*Picea engelmannii*)
Subalpine fir (*Abies lasiocarpa*)
Western redcedar (*Thuja plicata*)

DECIDUOUS

Rocky mountain maple (*Acer glabrum*)
Western paper birch (*Betula papyrifera*)
Quaking aspen (*Populus tremuloides*)
Black cottonwood (*Populus trichocarpa*)
Red alder (*Alnus rubra*)

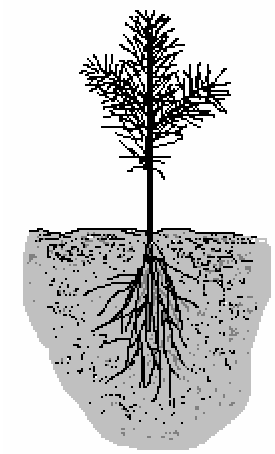
SHRUBS

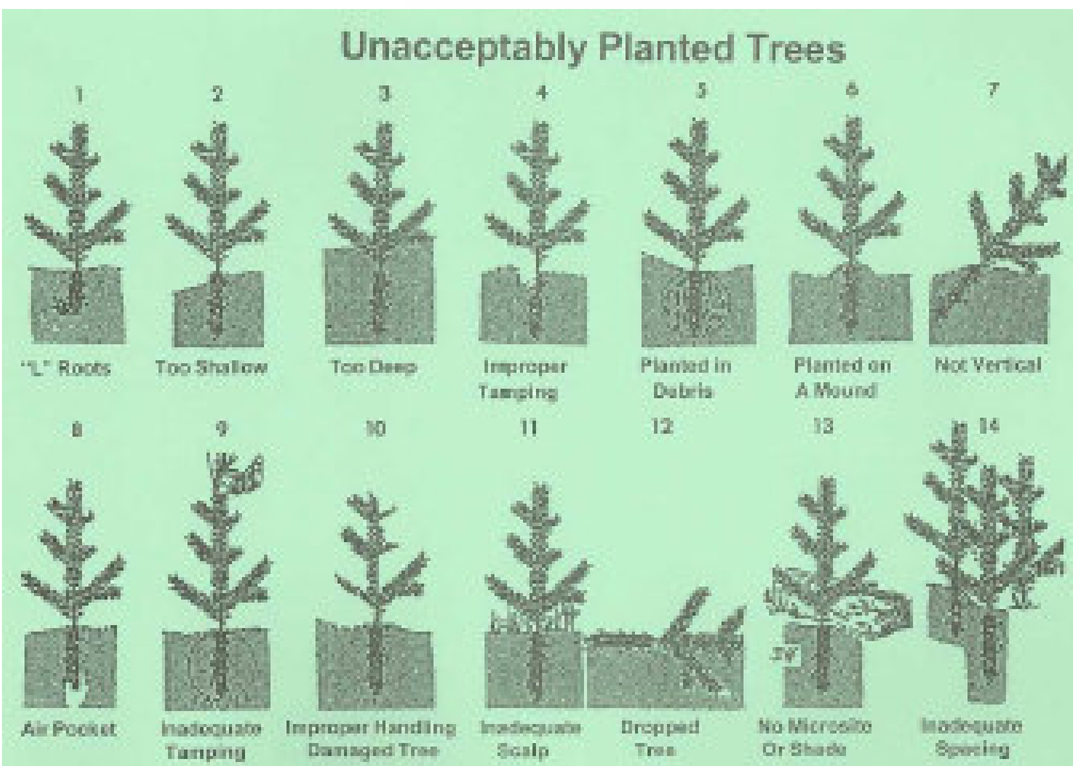
Ocean spray (*Holodiscus discolor*)
Snowberry (*Symphoricarpos albus*)
Ninebark (*Physocarpus malvaceus*)
Oregon grape (*Berberis repens*)
Pachistima (*Pachistima myrsinites*)

TREE PLANTING

For the contest, you will be asked to identify a tree that has been planted correctly from others that have not. The picture below shows a correctly planted tree. The next picture [the PDF file] shows a variety of incorrectly planted trees.

The correctly planted tree is oriented vertically in mineral soil with its roots spread outward and down. There are no large air pockets or loose soil. The soil is even with the **root collar** (the line on the stem showing the soil level when the seedling was grown in the nursery). Shade has been provided on the southwest side of the tree. Before planting, a two to three-foot area was "scalped" to remove vegetation (grass, etc.) that would otherwise compete with the tree for moisture and nutrients.





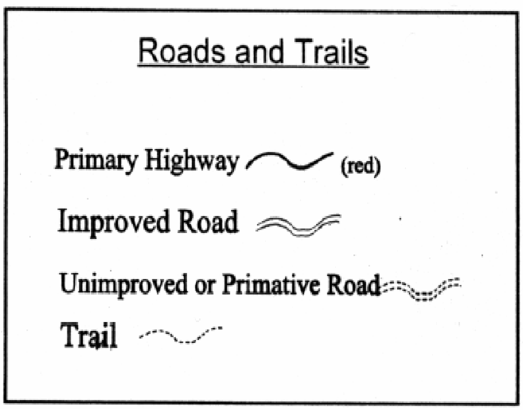
MAP READING

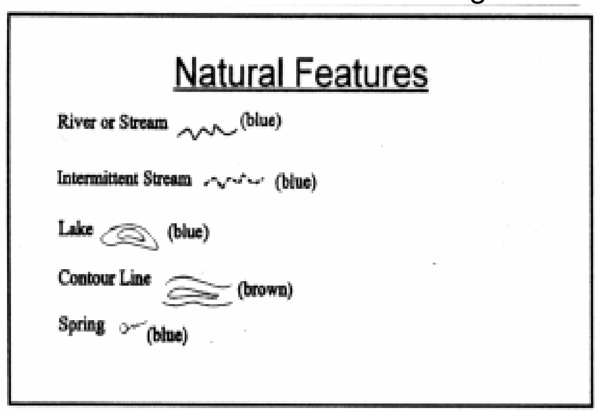
Foresters use various maps while planning and carrying out their daily activities. The map reading portion of the Forestry Contest will involve learning the following map skills:

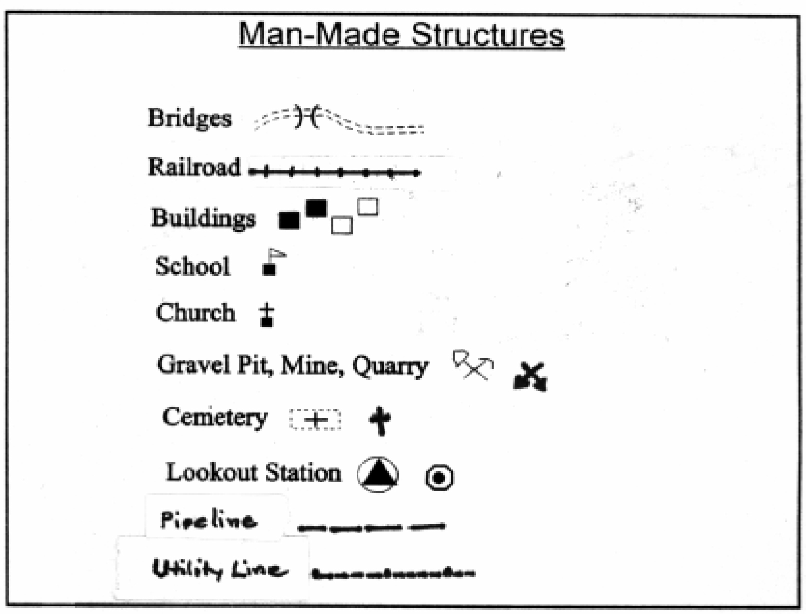
- Identifying standard map symbols
- Finding your location from locations markers and legal descriptions
- Identifying features on a topographic map
- Giving legal descriptions of map features

MAP SYMBOLS

The student will be expected to identify standard map symbols on a United States Geological map. The symbols will be selected from the following list:







TYPES OF MAPS

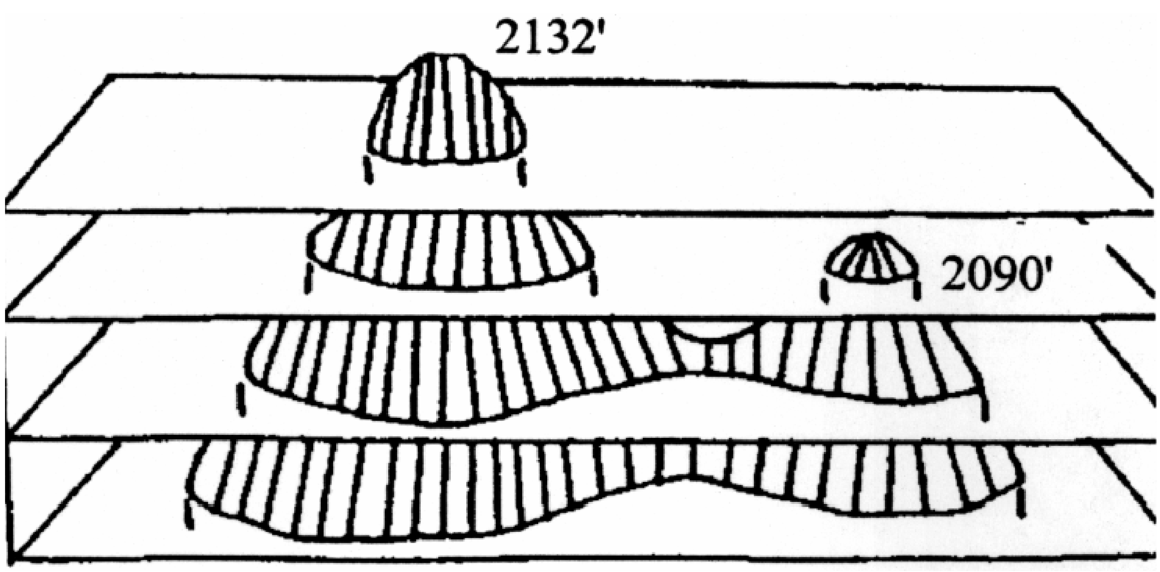
The two types of maps most frequently used by foresters are ***planimetric maps*** and ***topographic maps***. Planimetric maps show detail in a flat, 2-dimensional plane. The United States Forest Service Visitors Map is a good example of a planimetric map. It is scaled at ½ inch per mile and shows features such as streams, mountain peaks, roads and trails. It is usually color-coded to show various ownerships.

The **United States Geological Survey (USGS) maps** are topographic maps. The usual scale is 2½ inches per mile. They show the third dimension (3-D), or depth, as well as showing a high degree of detail in the flat (2-D) plane. Differences in ***elevation*** are shown by the use of contour lines.

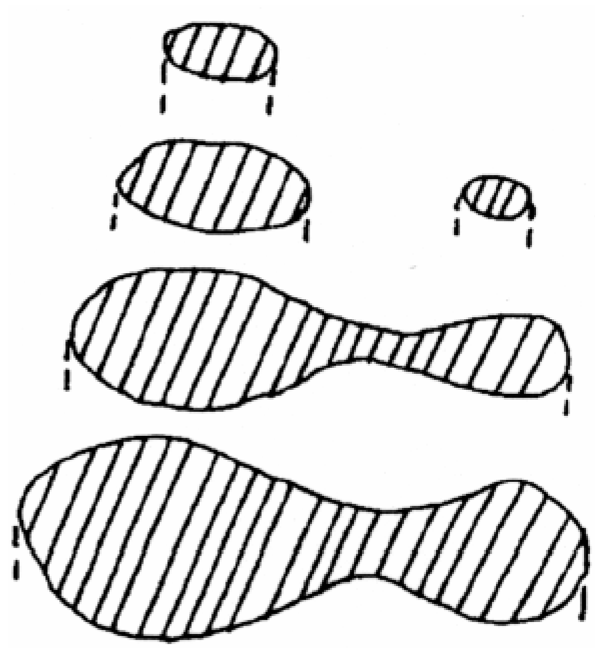
A ***contour line*** is an imaginary level line on the ground that connects all points of equal elevation. A contour line on a map indicates the elevation of that line above sea level. The *vertical* distance between two adjacent contours is known as the ***contour interval***. Contour intervals that are commonly used on maps are 20, 40, 80, or 100 feet.

A contour map is made by drawing around the edges of sections of the ground where those edges intersect with imaginary parallel planes at a given contour interval. The drawings below illustrate how this works:

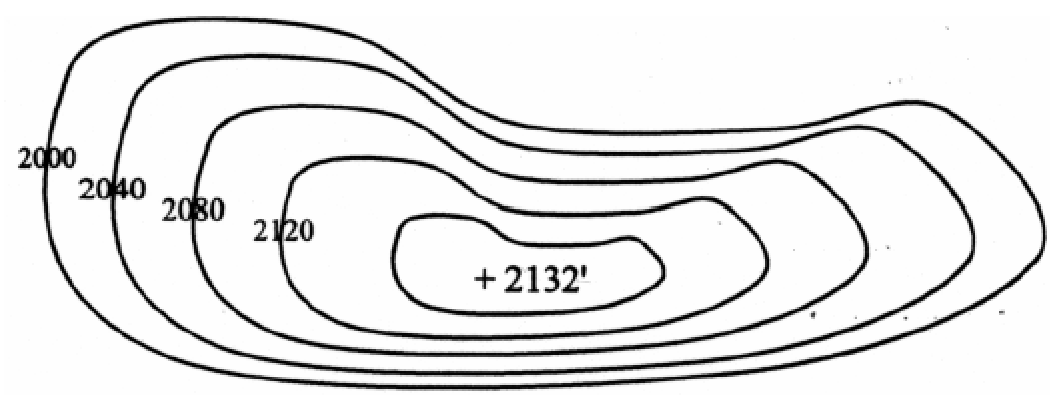
1) ***Parallel planes intersecting terrain at a 40 ft. contour interval***



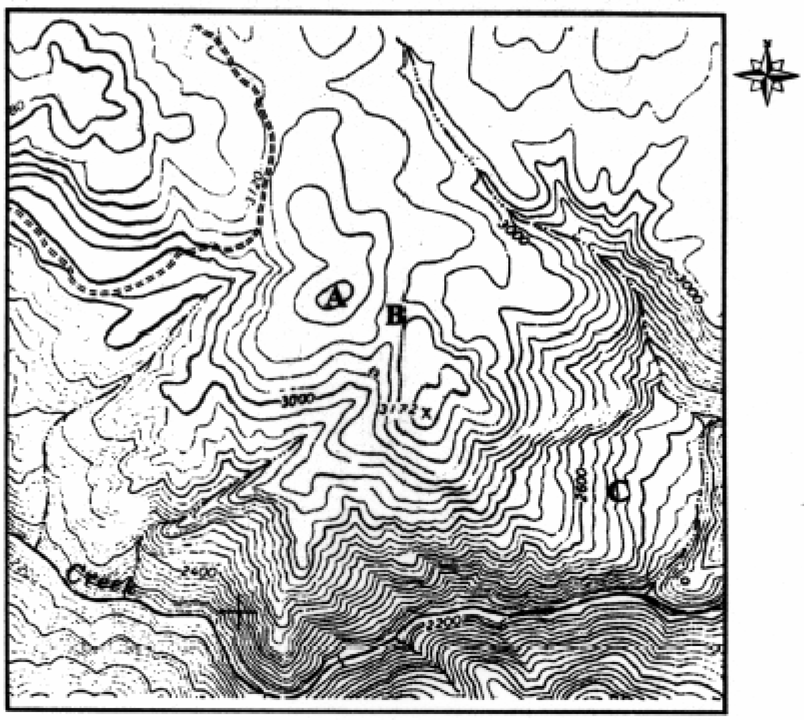
2) Sections cut by parallel planes, as seen from the top



3) Contour map of terrain (the sections are overlying each other)



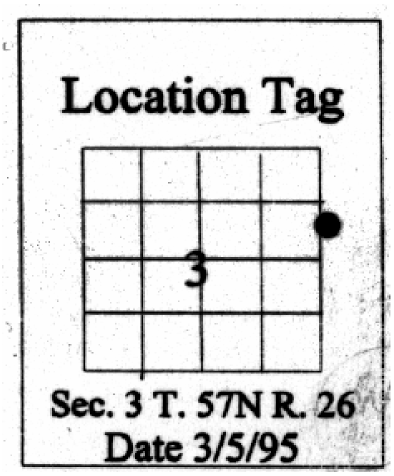
Characteristics of Contours: The following map illustration gives examples of the characteristics of contours described below.

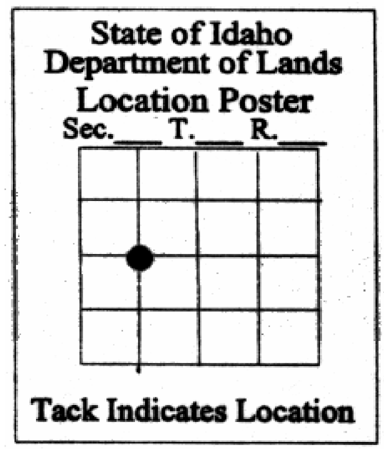


- All points on any contour line have the same elevation.
- Summits are indicated by closed contours, with no contour lines inside. Point **A** on the map is a summit.
- The depressions between summits are called saddles. Point **B** on the map is a saddle.
- In valleys and draws, the contour lines point uphill.
- On ridges, the contour lines point downhill.
- Contours never split or branch.
- The closer together the contour lines are to each other, the steeper the slope. The further apart the contours are, the flatter the slope.
- ***Aspect*** is the compass direction a slope is facing. Point **C** is on a slope with an east-facing aspect.

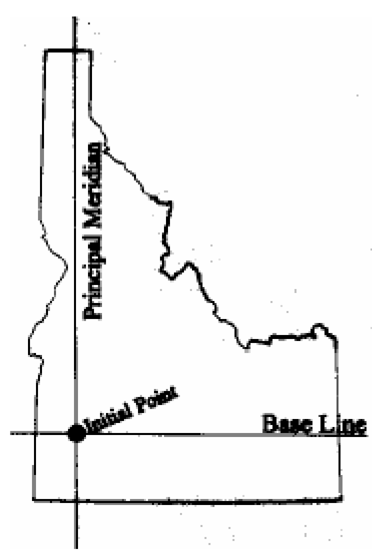
FINDING YOUR LOCATION

Foresters and surveyors establish location markers in the forest to help them locate exact position quickly and easily. The location markers are usually four- to six-inch metal signs, painted yellow, showing a simple map. These markers or "***tags***" are often situated alongside roads and are nailed to a tree or post. A small nail or tack indicates the exact location of the marker. Therefore, it is easy to pinpoint your exact position by comparing the tag location to a map of the area. The following illustrations show two typical location tags:

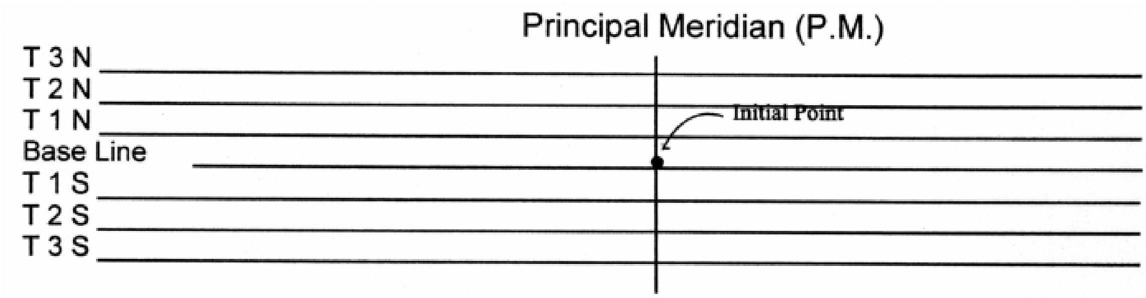




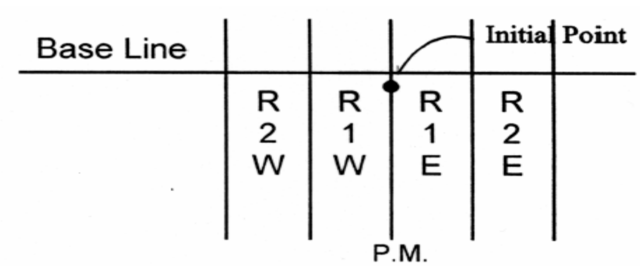
To better understand the use of location tags, a brief explanation of land surveying is necessary. A land survey consists of a series of parallel lines that form a grid over the state. The land survey starts at a point called the "initial point." An east-west line is established from this point and is called the "***Base Line***." The north-south line is established and is called the "***Principal Meridian***." The illustration below shows the initial point, the Base Line, the Principal Meridian and their relative position in the State of Idaho.



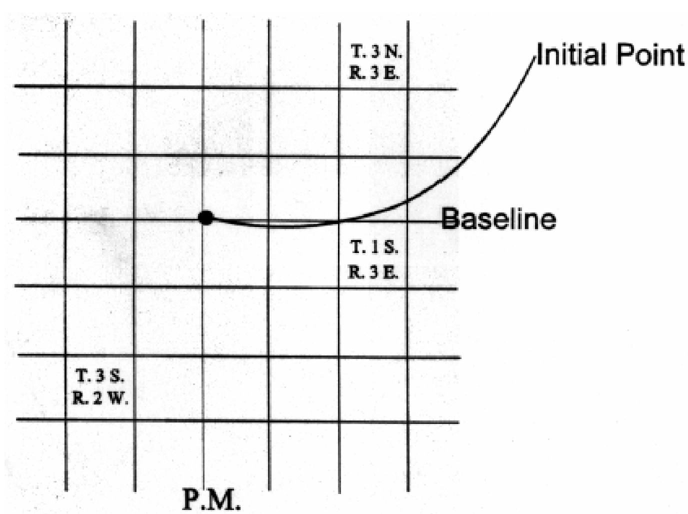
The state is subdivided by lines running at six-mile intervals, both parallel to the Base Line and to the Principal Meridian. The lines running east-west are called ***Township (T)*** lines and are numbered consecutively ***North (N)*** and ***South (S)*** of the Base Line. The first line north of the Base Line is *Township 1 North (T. 1 N.)* and the first line south of the Base Line is *Township 1 South (T. 1 S.)*, as illustrated below:



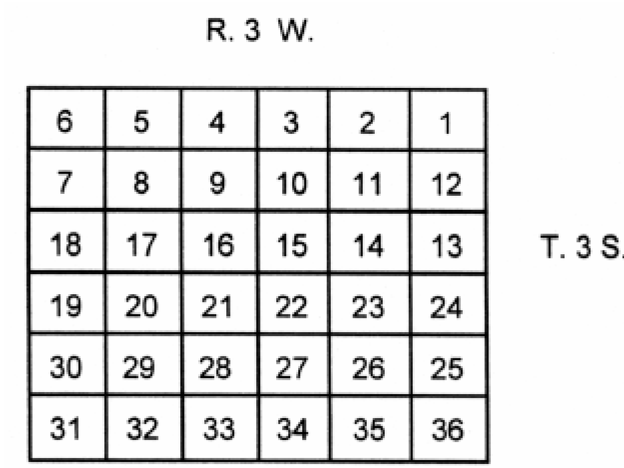
The lines running north-south at six-mile intervals are called ***Range (R)*** lines and are numbered consecutively ***East (E)*** and ***West (W)*** of the Principal Meridian (PM). *Range 1 East* is the first column to the right (east) of the PM. *Range 1 West* is the first column to the left of the PM, as illustrated below:



When you combine township lines and range lines on the same map, it makes a grid of squares that are each six miles square. Each square is called a ***township*** and its position can be identified as shown in the examples below:



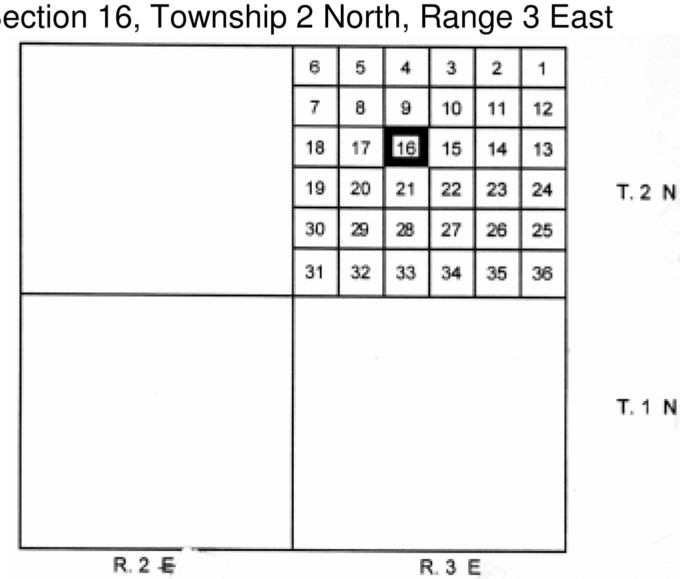
Townships (which have 6 miles per side) are further subdivided into 36 square miles called ***sections***. Each section is one square mile and contains 640 acres. The following system is used to number the individual sections in a township:



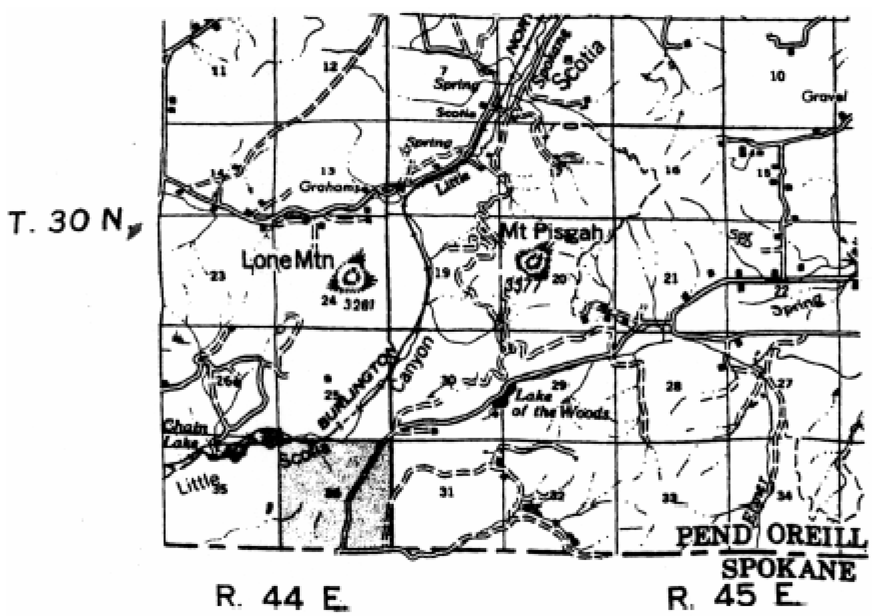
Legal descriptions are used to describe the exact location of townships, sections and even features such as mountain peaks or roads. The example below gives the legal description for a section of land as shown on the accompanying map:

Example:

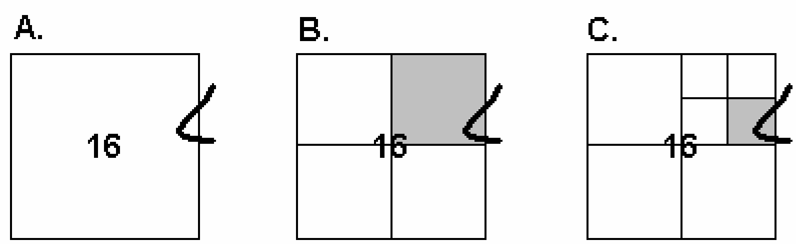
Section 16, Township 2 North, Range 3 East



If you look closely at either a U.S. Forest Service map or a USGS map, you will notice a superimposed grid of sections and townships. (It is sometimes difficult to see these lines due to physical features, names, and ownership lines.) Section numbers (1 through 36) are usually found in the middle of a section, while township numbers are listed vertically along the map's margin and range numbers are listed horizontally across the top and bottom margins of the map.



To give a legal description of the location of a feature within a section, you can subdivide the section into halves or quarters. For example, suppose you want to pinpoint the location of a loop of road in **Section 16, T. 2 N., R. 3 E.** (Diagram A).



If you divide Section 16 into quarters, you will see that the road is located in the *northeast quarter* of the section (Diagram B). Next, if you divide that northeast quarter into quarters, you will see that the road is located in the *southeast quarter of the northeast quarter* of the section (Diagram C). The legal description of the road loop would be written:

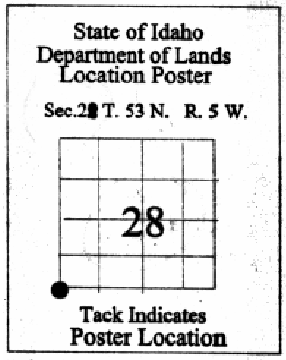
Southeast quarter of the Northeast quarter, Section 16,
Township 2 North, Range 3 East

This can be abbreviated to: **SE1/4 NE1/4 Sec. 16 T2N R3E**

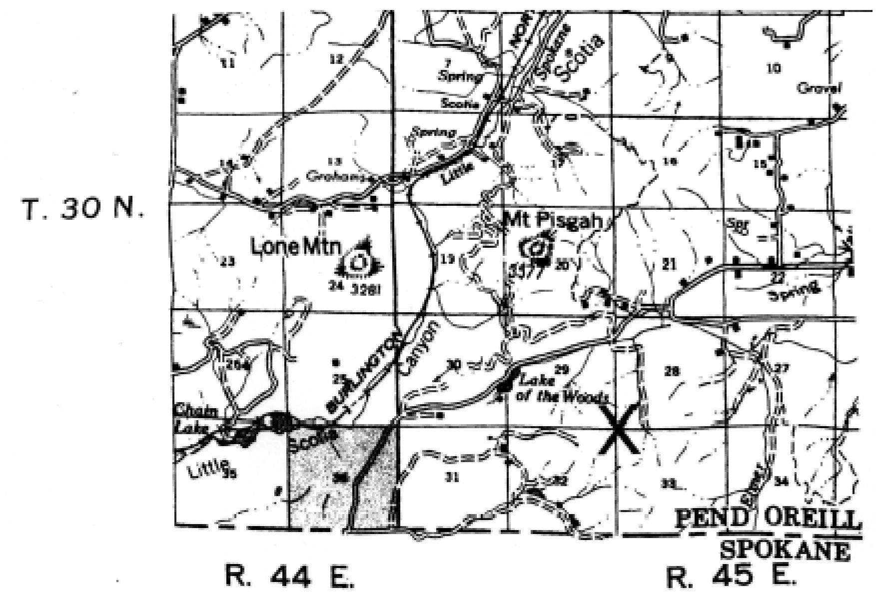
Now, let's return to the location marker and see how we can use it to determine our exact location in the forest.

EXAMPLE:

Suppose you are driving along a forest road and see a location tag like this:



Next, by looking at your map, you can determine that your location is on the section corner between sections 28, 29, 32, and 33 (see **X** on the map below).



With practice, you will easily be able to determine your exact location if you have a map of the area and find a location marker. It is suggested that you obtain a U.S. Forest Service Visitor Map and familiarize yourself with the layout of the sections and townships, and practice writing legal descriptions for map features.

COMPASS READING & PACING

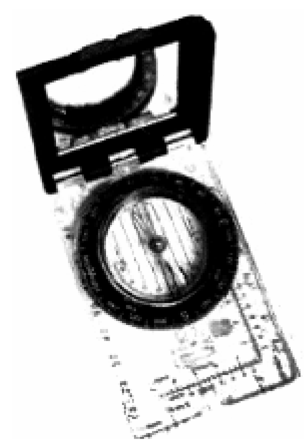
Two basic forestry skills that are practiced almost daily by foresters are using a compass and pacing.

COMPASS READING

The essential **parts of a compass** include a magnet, usually in the form of a ***needle***, which is balanced on a jeweled bearing or pivot, a ***graduated circle*** with 360º of azimuth or four 90º quadrants indicating the four cardinal directions of North (0º), East (90º), South (180º), and West (270º). These components are housed in a box or frame (called the ***baseplate*** on some kinds of compasses) that has a sighting device with which to aim at the objective. While all compasses contain these items, they are combined in such a myriad of designs as to make a generalized description difficult.

There are **three** basic parts of the Silva compass:

1. **Compass Needle.** The magnetic needle is attracted by the magnetic North Pole of the earth. The red end points North and the white end South.
2. **Compass Housing or Graduated Dial.** The compass housing is a dial that is graduated into the 360° of a circle. The compass housing can be rotated on the base plate. Each mark on the housing represents 2°. The bearing is read in degrees at the index pointer. The four principal directions are also indicated; North (0° and 360°), South (180°), East (90°), and West (270°). The orienting arrow is the black arrow that appears on the bottom of the housing.
3. **Base Plate.** The base plate along with the sighting mirror points out the objective, or the line of travel.



The most common type of compass used by foresters consists of a rectangular baseplate with a graduated dial that houses the needle and can be rotated, and a hinged mirror that is used for sighting (the Silva Ranger shown on this page is an example of this type of compass). This compass is fast to use, particularly on straight cruise lines, and is sufficiently accurate for most forestry applications.

This type of compass is filled with liquid to dampen the quivering of the needle. A screw in the graduated circle can be turned to set the declination on the arrow, thus permitting the running of true bearings (***declination*** is the variation between true north and magnetic north). The dial is graduated to 2º and estimated to 1º. With the compass aimed at the objective, the dial is turned until the north arrow within the dial is aligned parallel with the needle. The ***azimuth*** or ***bearing*** is read at the index mark. The sighting and aligning is done while observing the compass in a mirror on the inside of the hinged cover.

> ***DEFINITION:*** *An* ***azimuth*** *or* ***bearing*** *is the direction or degree reading from one object to another. For example, to go from Point A to Point B at an azimuth of 90º means that starting at Point A, you must travel due East (90º) to reach Point B.*

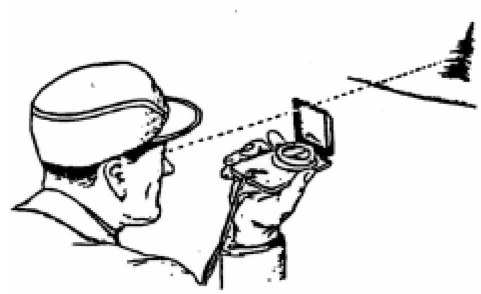
Foresters use compasses in many ways. Obtaining bearings from a map, taking bearings on the ground, giving directions, plotting locations on a map and on the ground, and laying out timber sale boundaries or roads are all examples of forestry-related uses for the compass.

The compass portion of the Forestry Contest will involve determining an azimuth from one object to another object. Therefore, taking an azimuth will be the only procedure discussed in this text. You may want to refer to one of the compass publications to learn the other procedures.

TAKING AN AZIMUTH

1. Face the object you are aiming at.

2. Holding the compass *level* at eye level and at arm's length, look at the dial of the compass through the mirror.



3. Next, line up your objective through the peep sight on the compass.

4. While looking at the dial through the mirror and continuing to hold the compass level, turn the compass dial (housing) until the orienting arrow (the arrow on the bottom of the dial) is lined up with the compass needle.

5. Double-check that:
   You kept the compass baseplate level throughout this operation;
   You are still sighting on the objective through the peep sight;
   The needle and the orienting arrow are lined up exactly.

6. Make adjustments as necessary.

7. Finally, read the azimuth at the ***index pointer*** or ***line-of-travel pointer*** (the little triangle on the baseplate by the hinge)

PACING

Pacing is the technique of measuring distances by knowing the length of your pace and counting the number of paces you take. Each two steps is called a ***pace***. It is easier and more accurate to count the number of paces rather than individual steps.

DETERMINING THE LENGTH OF PACE

People's average length of pace differs. To determine your own average length of pace, measure 100 feet on level ground using a tape measure. Using a normal stride, walk the 100-foot distance, counting the number of paces (i.e. if you started pacing with your right foot, count every time your left foot touches the ground as one pace.) Walk the 100-foot distance two more times, then take the average of the three pace counts. That is your average number of paces for 100 feet.

Now, divide your average number of paces into 100 feet to determine your average length of pace.

EXAMPLE A

You paced the 100-foot line three separate times. The walks resulted in 21 paces, 19 paces and 20 paces, respectively. Your average number of paces for 100 feet is

21 + 19 + 20 = 60, divided by 3 = <u>20 paces for 100 ft.</u>

Now determine your average length of pace:

100 feet divided by 20 paces = <u>5 feet per pace</u>

Once you know your average length of pace, you can calculate the distance from one point to another by pacing. To determine the distance between points, count the number of paces and multiply by the length of your pace.

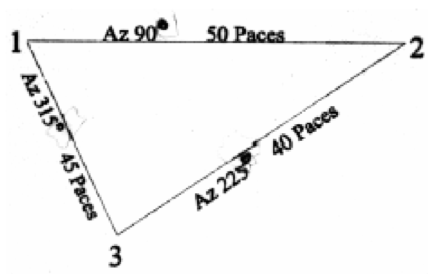
EXAMPLE B

A________________ ← 25 paces → ________________B

25 paces x 5 feet/page = 125 feet
from Point A to Point B

COMBINING COMPASS READING AND PACING

The compass reading and pacing portion of the forestry contest will combine both skills. Here is a sample layout of a compass course:



(Assuming your average pace is 5 feet)

Stations	Compass Azimuth	Measured Distance
1 - 2	90°	250 feet (50 paces X 5 feet)
2 - 3	225°	200 feet (40 paces X 5 feet)
3 - 1	315°	225 feet (45 paces X 5 feet)

TOOL IDENTIFICATION

The objective of this contest is to familiarize students with some of the basic and commonly used tools and instruments in the forestry profession.

The tools that are used in the contest have been divided into 6 categories according to their purpose. The categories include tools used for:

a) Cruising
b) Measuring distance & direction
c) Tree planting
d) Safety
e) Cutting wood/brush
f) Miscellaneous

The best way for a student to learn to identify the tools is to have a forester display them in a 'hands on" demonstration. As an aid for those who cannot participate in a demonstration, pictures provided by three forestry supply catalog companies* are included at the end of this chapter.

The following is a listing of tools to be identified in the contest:

- Tools used for **cruising**:

  Relaskop
  Diameter tape
  Clinometer
  Prism
  Increment borer
  Cruiser's vest
  Tatum

- Tools used for **measuring distance & direction**:

  GPS unit
  Hand compass
  Hip chain
  Logger's Tape
  Steel chain

- Tools used for **tree planting**:

  Hoedad
  Planting bar
  Planting bag
  Planting spade/shovel

- Tools used for **safety**:

  Caulk (Cork) Boots
  Chaps
  Hard Hat
  Leather gloves
  Safety glasses

- Tools used for **cutting wood/brush**:

  Cruiser's Axe
  Chainsaw
  Pulaski

- **Miscellaneous** tools:

  Computer
  Drip Torch
  Plastic flagging
  Pocket Stereoscope
  Maps & Aerial Photos
  Tree Marking Gun

*Forestry supply catalogs used as sources for pictures:

Ben Meadows Co. Second Edition 2004
1-800-241-6401
www.benmeadows.com

Terra Tech, Inc. Catalog 23 (2000)
1-800-321-1037
www.terratech.com

Forestry Suppliers, Inc. Catalog 55 (2004-2005)
1-800-647-5368
www.forestry-suppliers.com

Tools used for CRUISING

Cruiser's vest

Tatum

Clinometer

Increment borer

Relaskop

Prism

Diameter tape

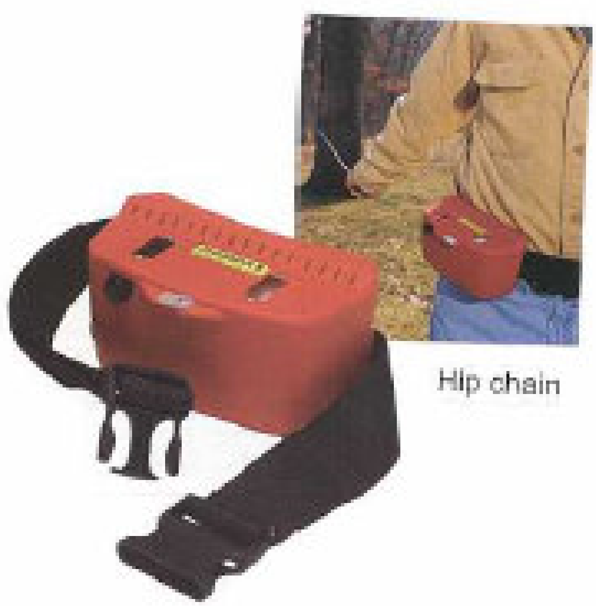
Tools used for MEASURING DISTANCE AND DIRECTION

Hand compass

Logger's Tape

GPS unit

Steel chain



Hip chain

Tools used for **TREE PLANTING**

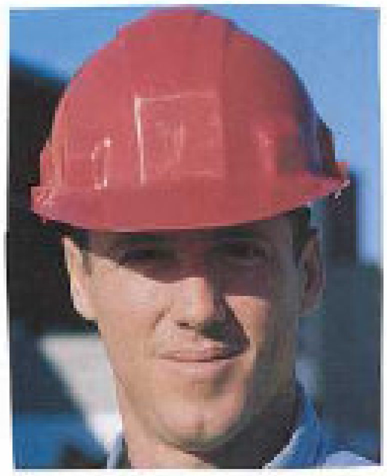
Planting bar

Planting bag

Planting spade/shovel

Hoedad

Tools used for SAFETY



Hard Hat

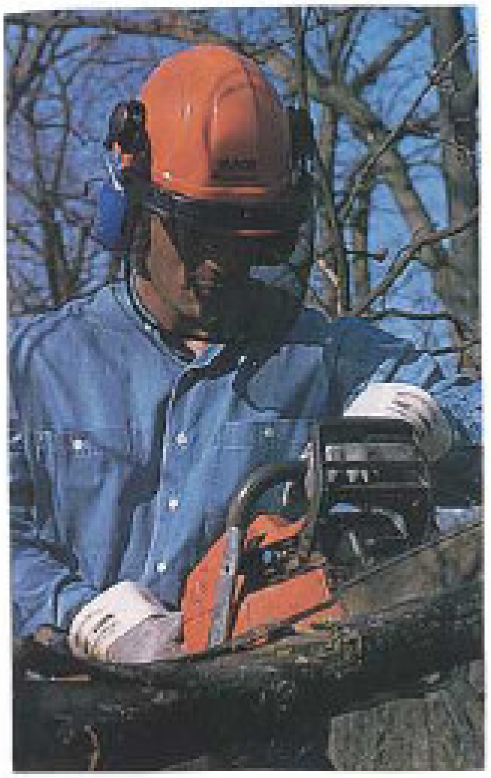
Leather gloves

Safety glasses

Chaps

Caulk (Cork) Boots

Tools used for CUTTING WOOD / BRUSH



Chainsaw

Cruiser's Axe

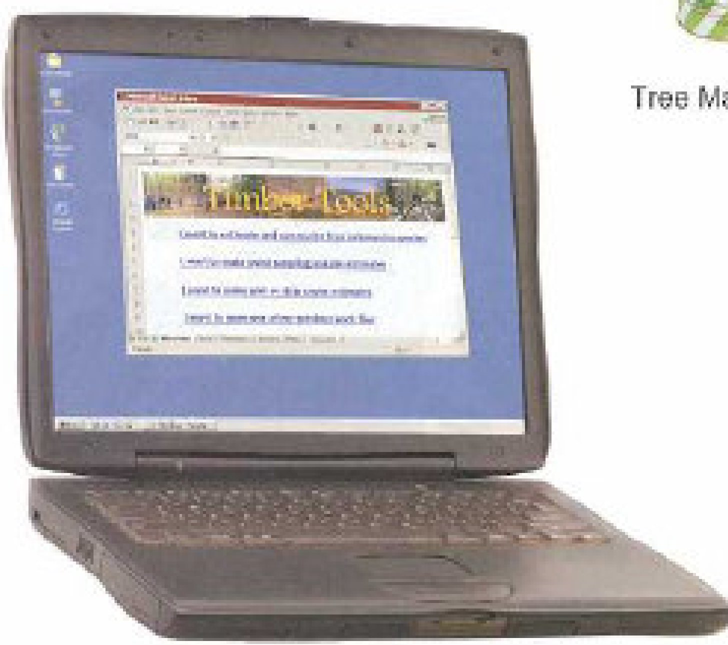
Pulaski

MISCELLANEOUS TOOLS

Plastic flagging

Tree Marking Gun

Drip Torch



Computer

Maps & Aerial Photos

Pocket Stereoscope

SOILS and WATER QUALITY

SOILS

Soil can be defined as a natural body developed from a mixture of broken and weathered mineral material (rocks) and decaying organic material (remains of living organisms). Soil covers the earth in a relatively thin layer. It supplies are, water and nutrients for plant growth. Soil also provides mechanical support for plants, buildings and other types of construction.

Plants and animals derive support and nutrients directly or indirectly from the soil. As plants and animals live and die, their waste products and remains are returned to the earth to form the organic fraction of the soil. The development of *one (1) inch of soil* may require many *hundreds* of years under natural conditions.

Soils differ in their potential to produce food and fiber and in their usefulness for construction sites and other nonagricultural uses. The best use and management of any given plot of land is based upon characteristics of the soil comprising that plot of land. Knowledge of soil characteristics is necessary to determine proper management and what conservation measures are necessary to ensure proper land use.

Soil engineering properties and interpretations may also be determined using the soil characteristics and potential problems as a basis. These properties and interpretations may be used for selecting suitable sites for building houses, locating roads, planning parks and playgrounds, and many other construction uses of soil.

SOIL PROFILE

Each soil is unique and made up of distinctive layers called ***soil horizons***. The various horizons or sequence of horizons make up a ***soil profile***. The soil profile develops as the result of the interaction of five soil-forming factors: *climate, organisms, parent material, topography and time*. The soil profile is usually not over 5 feet thick, since this is as deep as weathering processes generally go.

Types of Soil Horizons

A soil horizon is a layer of soil usually lying parallel to the surface. It has a unique set of physical, chemical and biological properties. The properties of soil horizons are the results of soil-forming processes. Variations in these properties cause each horizon to be distinct from adjacent horizons.

Soil horizons are named using combinations of letters and numbers. Six general kinds of horizons, called ***master horizons***, may occur in soil profiles. These master horizons are named with capital letters: **O**, **A**, **E**, **B**, **C**, and **R**. A single soil probably never contains all six master horizons. Most Idaho soils have A, B, and C horizons. Other Idaho soils have an A horizon resting directly on a C horizon, or an A-E-B-C horizon sequence, or even an O-E-B-C sequence. The illustration below shows a theoretical soil profile with all 6 master horizons:

O Litter layer

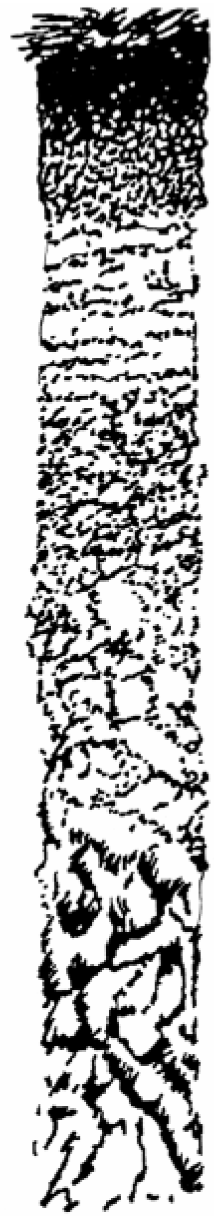
A Mineral surface horizon, dark colored, granular structure

E Strongly leached horizon, light colored, platy structure

B Subsoil horizon of maximum development, “brown”, blocky structure

C Weathered “parent material”, “brown”, massive structure

R Hard bedrock



Each master horizon has a distinct set of properties, which are described on the next page.

O Horizon – An O horizon is composed of organic material (***litter***). It does not have to be 100 percent organic material, but most are nearly so. Forest soils usually have thin organic horizons at the surface. They consist of leaves, twigs, and other plant materials in various stages of decay. Wet soils in bogs or drained swamps often have only O horizons.

A Horizon – The A horizon is the surface horizon of a mineral soil. It has a ***granular*** structure. The unique characteristic of an A horizon is the dark color formed by the ***humus*** content. The thickness of A horizons ranges from a few inches in low precipitation (desert) rangeland soils, to 20 inches or more in the Palouse area of northern Idaho.

The A horizons are extremely important in maintaining soil fertility and providing favorable environment for root growth. They should be protected from erosion or compaction. The A horizons are usually the horizons that are referred to as "***topsoil***." Topsoil is a less definitive term: It usually refers to the top 6 to 12 inches of the profile and may actually include no A horizon, as in the case of severely eroded or scraped areas.

E Horizon – This horizon has a light gray or whitish color. It is present only in areas relatively high precipitation. It usually occurs immediately beneath an O or A horizon.

E horizons are light colored because nearly all the iron and organic matter has been removed or ***leached*** out. (**Contest Hint:** *Think of "E" for "Exit" or leaching.*) E horizons exhibit a "***platy***" structure.

B Horizon – The B horizon has the brightest yellowish-brown or reddish-brown color and a "***blocky***" structure. Many B horizons have more clay than any other horizons in the profile and show evidence of clay accumulation. B horizons are part of the subsoil. They are the subsoil horizon with the maximum amount of development.

In cases where the A horizons have been completely lost by erosion or some other (usually) man-caused reason, the B horizon may be at the surface and thus constitutes the "topsoil."

C Horizon – The C horizon is composed of weathered geologic or ***parent material*** found below the A or B horizon. It is "brown" in color and has a massive structure. Any material that is loose enough to be dug with a shovel but has not been changed appreciably by soil forming processes is considered to be a C horizon. The C horizon is also considered to be part of the subsoil. The sand and gravel deposits of glacial outwash and till in northern Idaho are examples of a C horizon.

R Horizon – The R horizon designation is used for ***bedrock***. Bedrock consists of hard, relatively unweathered rock material. Depending on the depth to bedrock, the R horizon may occur directly beneath any of the other master horizons.

Soil Texture (Surface and Subsoil)

Texture is the proportion of sand, silt and clay-sized soil particles making up the soil minerals. Texture is an important soil property because it is closely related to many aspects of soil behavior. The ease of tilling the soil and the ease of plant root development within the soil are both influenced by soil texture. Texture affects the amount or air and water a soil will hold and the rate of water movement into and through the soil.

Plant nutrients are also related to soil texture. Tiny silt and clay particles provide more mineral nutrients to plants than large sand grains. The productivity of sandy soils can be improved through proper management, but these soils require more fertilizer and more frequent irrigation (watering) than soils with higher percentages of silts and clays.

There are **three size classes of soil particles**: *sand, silt and clay.*

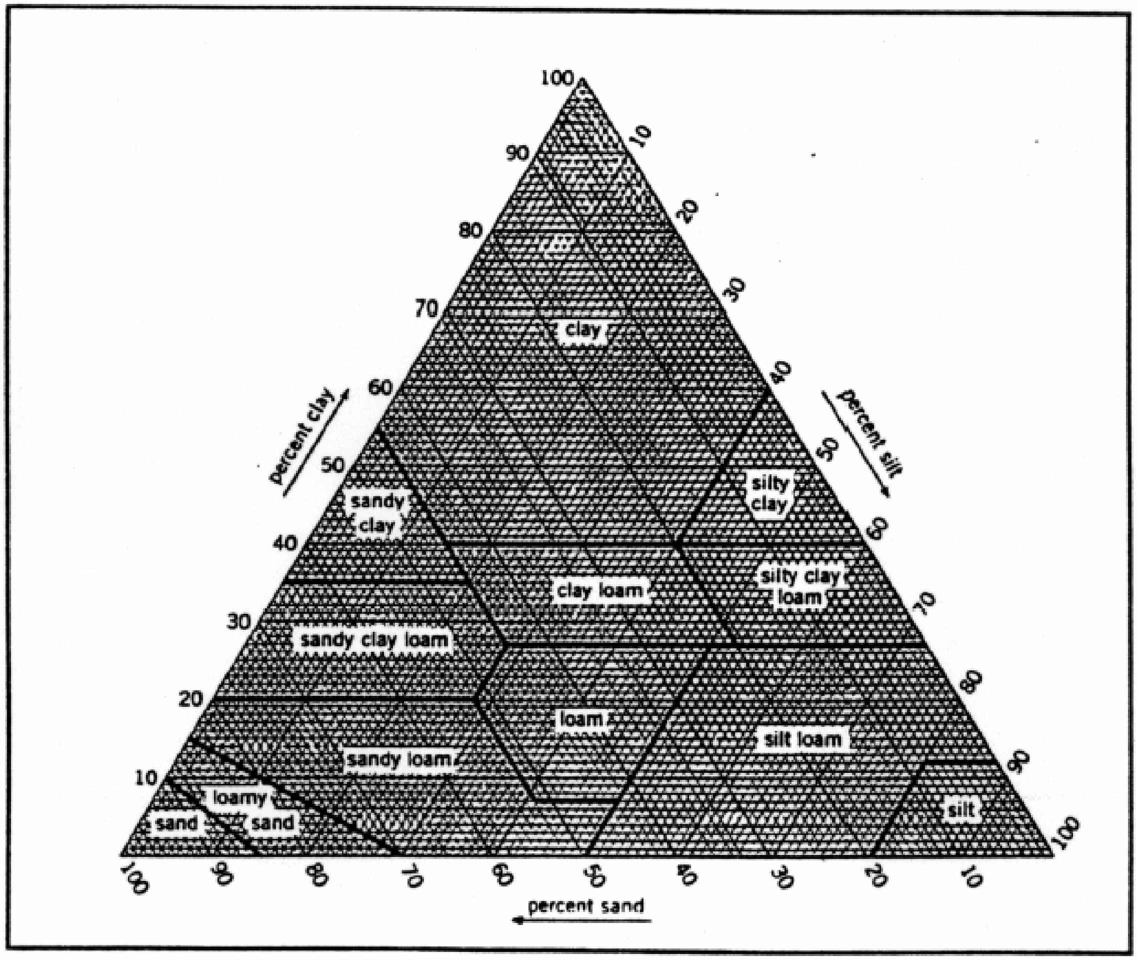
- ***Sand*** particles provide more mineral nutrients to plants than large sand grains. Sand particles range in size from 0.05 mm to 2 mm. They are large enough to see with the naked eye, and they feel gritty.

- ***Silt*** particles cannot be seen without a hand lens or microscope. Silt feels smooth, like flour or corn starch. It is not sticky.

- ***Clay*** particles are less than 0.002 mm in size. They can be seen only with extremely high-powered microscopes. Clay feels sticky when wet and can be molded into “ribbons” or “wires” or other forms much like modeling clay.

CONTEST TIP*:* In the contest, a sample of soil material taken from the profile will be placed in a container at the contest site to be used for judging textures. You will be asked to name the soil texture (i.e. sandy loam, clay loam, silt loam, etc.), as determined by the relative amounts of sand, silt or clay that are present.

The Textural Triangle



Every soil contains a mixture of various amounts of sand, silt and clay. Since there are three size classes of particles, a three-sided ***textural triangle*** is used to show all the possible combinations.

Precise boundaries between ***textural classes*** are shown in the textural triangle diagram above. Each side of the triangle is the base line or "zero point" for the particle size in the opposite corner. If we know how much sand, silt, and clay a soil has, we can easily plot that soil's location on the triangle and see which textural class it falls into.

A soil that is composed of primarily sand-sized particles would lie very close to the sand corner of the triangle. Its *textural class* name would simply be "*sand.*" Similarly, a soil dominated by clay would lie near the clay corner of the triangle and would be called "clay."

Now, consider a soil with a mixture of sand, silt and clay. All three are present, but not in exactly equal proportions (and it actually takes less clay to "balance" the mixture than either sand or silt). This type of soil will fall into the lower central part of the triangle and would be called a **loam**.

Using the Textural Triangle to determine the textural class of a soil:

Suppose we have a soil that contains 40 percent sand, 45 percent silt, and 15 percent clay.

Start with the clay content: Find to the midpoint of the base line that lies between sand and silt (i.e. the base line at the bottom of the triangle). From there, go vertically up to the 15 percent clay line (the percent of clay is shown on the left side of the triangle). *Every soil on this (horizontal) line contains 15 percent (15%) clay.*

Next, locate the 40 percent (40%) sand line (the percent of sand is shown on the base line at the bottom of the triangle, opposite the clay corner). The 40% sand line runs diagonally up and to the left (i.e. parallel to the right side of the triangle). Find the point where the 15% clay line and the 40% sand line intersect. Mark that point.

Now, if you wish, you can find the 45% silt line (on the base line between silt and clay) and follow it diagonally down and to the left until it intersects with the 15% line. However, *it takes only two points to determine the soil texture*. This sample is a *loam*.

Determining Soil Texture in the Field

Soil scientists recognize 12 soil textural classes, as seen in the textural triangle. For the purpose of the Forestry Contest, texture will be determined into only the three basic textural classes: ***sandy***, ***silty loamy***, or ***clayey***.

Basic Soil Textural Classes

	Sand		
Clay	**>50%**	**20-50%**	**<20%**
>40%	sandy or clayey	clayey	clayey
27-40%	sandy	silty/loamy	silty/loamy
<27%	sandy	silty/loamy	silty/loamy

Determining Soil Texture by Feel

1. Fill the palm of your hand with dry soil.

2. Moisten the soil enough so that it sticks together and can be worked with the fingers. Don't saturate it to runny mud. If the soil sticks to your fingers, it's too wet to tell texture. Add more dry soil.

3. Knead the soil between your thumb and fingers. Take out the pebbles and crush all the soil aggregates. You may need to add a little more water. Continue working the soil until you crush all the aggregates.

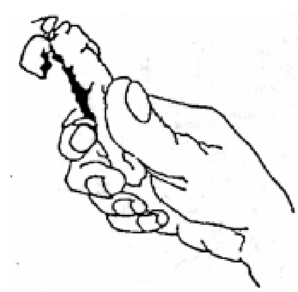
4. Estimate the sand content by the amount of textural grittiness you feel.

   a. More than 50% = sand dominates. The textural name is probably *sandy*.

   b. 20 – 50% = sand is noticeably present but not dominant.
   The texture is most likely *silty/loamy.*

   c. Less than 20% = silt and clay dominate.
   The textural name is either *silty/loamy* or *clayey.*

5. Estimate the clay content by pushing the sample up between your thumb and index finger to form a ribbon.



   a. Less then 27% = the ribbon is less than 1 inch long.
   The textural name is either *sandy* or *silty/loamy.*

   b. 27 – 40% = the ribbon is 1 to 2½ inches long.
   The textural name is either *silty/loamy* or *clayey*.

   c. More than 40% = clay dominates and the ribbon will be more than 2½ long. The textural name is *clayey*.

6. Combine your estimates of sand and clay to determine the textural name.

Soil Depth

The depth of soil includes the total thickness of the soil horizons readily penetrated by plant roots, water and air. A restrictive layer may be dense clay, hardpan or bedrock. There are *five classes of soil depths*:

1) Very Shallow = soils less than 10 inches deep
2) Shallow = soils 10 to 20 inches deep
3) Moderately Deep = soils 20 to 40 inches deep
4) Deep = soils 40 to 60 inches deep
5) Very Deep = soils more than 60 inches deep

CONTEST TIP: You will be expected to be able to identify the:

→ Texture of the A horizon

→ Thickness of the A and B horizon

→ Effective rooting depth

→ Percent of rock fragments in the whole soil by volume

FORESTRY INTERPRETATIONS for SOILS

By identifying the properties of a soil, a user can make predictions about the success of various uses. Foresters, for example, can use the knowledge of soil properties to help determine how difficult reforestation will be or how severe the hazard of windthrow is. The following two forestry interpretation charts are used to determine the limitations ratings (i.e. the expected difficulties or risks) for reforestation and windthrow.

Reforestation is the planting or natural regeneration (growth) of tree seedlings. Soil factors that influence tree seedling survival are:

- Rooting depth
- Texture (as related to water-holding capacity)
- Thickness of the A horizon

The chart on the next page shows how variations in effective rooting depth, soil texture, and soil thickness affect tree survival (Rating).

This chart predicts the likelihood of tree seedling survival (for planting adapted tree species and for naturally regenerating seedlings) in each of the soil types listed.

Effective Rooting Depth	Texture of A Horizon	Thickness of A horizon	Rating
>40 inches	Sandy	0-10”	moderate
		>10”	slight
	Silty/loamy, Clayey	any	slight
20-40 inches	Sandy	0-10”	severe
		>10”	moderate
	Silty/loamy, Clayey	0-10”	moderate
		>10”	slight
<20 inches	Sandy	any	severe
	Silty/loamy, Clayey	0-10”	severe
		>10”	moderate

Windthrow Hazard is the susceptibility of mature trees to be blown over during strong winds. The soil factors that influence windthrow hazard are effective rooting depth and texture. The chart below shows the effect these two factors have on windthrow hazard.

Effective Rooting Depth	Surface Texture	Rating
>40 inches	Silty/loamy, Clayey	slight
	Sandy	moderate
20 to 40 inches	Silty/loamy, Clayey	moderate
	Sandy	severe
<20 inches	any	severe

WATER QUALITY

We hear a lot of talk about "water quality," but what does that all that talk mean? How do we know if our water is clean?

Water contains many substances besides "H20." Minerals, for example, give water its taste and are necessary for health. They are found naturally in water, as are many other substances. But when these substances become too plentiful, they change from being harmless materials to "***pollutants***."

The amount of a substance that is *safe to allow* in water depends on the use of the water. The water from the tap at home should be crystal clear and free of bacteria, right? But what about the water used for livestock or for irrigating the garden? Water used for various activities requires different levels of purity and protection. In Idaho, ***safety levels of pollutants*** have been established for the following activities or uses:

- Domestic Water (drinking and other household activities)
- Cold Water Fisheries (trout and their cousins)
- Warm Water Fisheries (sunfish, bass, and their relatives)
- Trout Spawning
- Swimming
- Wading and Boating
- Irrigation
- Livestock Watering

The quality of water is determined by its chemical and physical characteristics. If they are outside the safe range, the water is considered polluted. These are some of the things about water that we look at:

1. Suspended Solids

Suspended solids are material carried in streams and rivers; these can be filtered out of the water. They include particles of sewage and animal wastes, decaying plants, industrial wastes, and soil particles. Soil particles in water are called ***sediment***. Suspended sediment gets into water through the process of erosion. This occurs when water runs over land not covered with vegetation. Suspended sediment reduces water clarity, fills in reservoirs, increases treatment costs of drinking water, interferes with irrigation by decreasing pump life and increasing ditch-cleaning costs, and reduces habitat for aquatic organisms.

2. Dissolved Oxygen

Creatures that live in water need oxygen that's dissolved in water to survive. Oxygen gets into water from the air or is released by aquatic plants.

Some of the factors that affect the amount of oxygen dissolved in water include:

- ***Temperature*** – Cold water holds more oxygen
- ***Altitude*** – Air is thinner at higher altitudes
- ***Plants in water*** – Photosynthesis releases oxygen into the water
- ***Decaying Materials in Water*** – The decomposition of dead algae, leaves, and wastes uses up oxygen
- ***Turbulence*** – Rocky stream bottoms increase oxygen
- ***Depth*** – The greater the surface area, the more oxygen is absorbed
- ***Velocity*** – Moving water absorbs more oxygen
- ***Shading*** – Affects temperature and photosynthesis
- ***Ice Cover*** – Prevents contact between air and water

Dissolved oxygen normally ranges between 8 and 15 parts per million (ppm). Since oxygen requirements vary among aquatic organisms, Idaho has set a minimum level of 5 ppm for warm water fish, and 6 ppm for cold water fish (except below dams).

3. Parts Per Million

Most pollutants are harmful at very low levels, so their quantity is reported in ***parts per million*** (abbreviated to ***ppm***). One drop of a substance in 26 gallons of water is about 1 ppm. You will also see pollutants reported in ***milligrams per liter*** (***mg/l***), but it still means parts per million. For ***toxic materials***, the units are often ***parts per billion*** (***ppb***). ***Micrograms per liter*** (**μg/l**) also means ppb.

4. Temperature

There is an ideal temperature range for each creature that lives in water. Cold water fish, like trout, do best at temperatures between 50º and 58º F. Water temperatures over 70º F can cause problems for them. Warm water fish, like sunfish and bass, can survive in 92º F water. Temperatures outside the fishes' ideal range may not kill them, but can cause a lot of stress. Fish can't reproduce at high temperatures, they grow less, and are more susceptible to disease and harm from pollutants in warmer water. Other creatures that fish need for food are also sensitive to temperature changes, so warmer water may cause a reduction in the food supply.

5. pH

pH is a measurement of acidity - in this case, it measures whether water is ***acidic, basic or neutral***. Specifically, pH is a measure of hydrogen ion activity in water and is measured on a scale from 0 to 14, with 7 representing the neutral point. Values below 7 are acidic and values above 7 are basic. Most natural waters are buffered by minerals like bicarbonates (e.g. the active ingredients in baking soda) that keep pH values in the 6.5 to 9.0 range.

pH is important because it affects most chemical processes that occur in water. For example, in water with a high pH, metals are non-toxic, but at low pH the metals are actively toxic. ph also affects the makeup and size of communities of creatures in water. Generally, low pH waters have fewer species and a much lower rate of productivity, so they support a much smaller fish population than waters with higher pH values

6. Bacteria

Bacteria are measured in water to see if disease-causing organisms (such as viruses, parasites, and bacteria) are present. It is impossible to test for all the disease bearing organisms that can occur in water, so tests are done to see if one bacterial group is present. This bacterial group, called ***fecal coliform***, consists of beneficial bacteria that exist in the intestines of warm-blooded animals. If fecal coliforms are found in water, it's likely that other organisms that cause health problems could also be present.

In Idaho, maximum safety levels for fecal coliform are:

- Wading or Boating: 200 bacteria colonies per 100 ml
- Swimming: 50 bacteria colonies per 100 ml
- Drinking: 1 bacteria colony

7. Nutrients

Nutrients stimulate plant growth in water in the same way they stimulate growth of a house plant in a flower pot or crops in a field. Microscopic plant life called ***algae*** causes a green scum on rocks or, as a floating form, causes a "pea soup" color in lakes and ponds. Larger aquatic plants are called "tules" or "seaweed" in lakes and are known as "mosses" when found in irrigation ditches. When this aquatic plant growth is excessive, it can interfere with recreational uses such as boating and swimming, cause odors when it decays, clog pipes and ditches, and reduce oxygen to levels that are harmful to fish. Too many nutrients speed up the natural aging of lakes, a process in which lakes are filled with plant growth and become swamps or bogs.

The most common nutrients in water are nitrogen and phosphorus, which are the same nutrients that are used on farms and gardens as fertilizer. Nitrogen gets into water from the air (80% of air is nitrogen gas), sewage or animal wastes, fertilizer, and soil that washes into the water. Generally concentrations of inorganic nitrogen above 0.3 ppm and of phosphorus above 0.1 ppm are considered unacceptable.

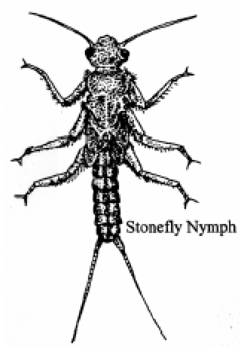
8. Turbidity

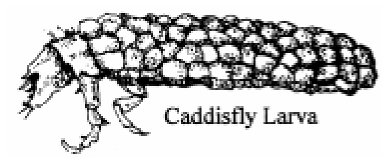
Turbidity refers to the murkiness of water, with zero turbidity indicating clear water. Turbidity is determined by shining a beam of light through a sample of water and measuring the amount of light that is reflected off the particles in suspension. Water with turbidity higher than 25 units looks dirty, and is considered to be harmful to fish and other aquatic organisms.

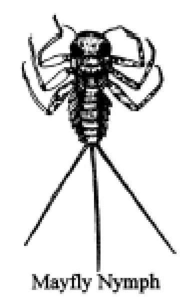
9. Biological Indicators

One way to determine if a body of water is healthy is to look at the creatures living in the water. We can see what kind of ***macroinvertebrates*** live in a stream. “Macro” means big enough to be seen with the naked eye. “Invertebrates” means animals without backbones. Insects, small crustaceans and snails are all macroinvertebrates that live in water.

A healthy stream has a wide variety of macroinvertebrates including some that are sensitive to pollution such as *caddisflies, mayflies and stoneflies*. These creatures are the source of food for trout. In a polluted stream, this variety is reduced to only a few species that are more tolerant of pollution. These species often multiply quickly and, in some cases, become nuisances.







10. Toxicity

Many toxic materials are ***soluble*** (i.e. they dissolve) in water. Among the most common are organic compounds (like pesticides and herbicides) and heavy metals such as lead, mercury and cadmium. These compounds may be lethal to fish and other aquatic organisms or may cause more subtle effects such as reduced growth or failure to reproduce.

WATER QUALITY and FORESTRY

Forestry practices such as timber harvest, road construction, skidding, and log hauling can have a positive or negative effect on water quality. Poor road construction and/or poor skidding practices can account for up to 90% of the soil erosion entering streams. Intermittent streams can contribute a significant amount of sediment to year-round streams. Thus, both intermittent and year-round streams need to be protected.

We can protect our streams by using a set of stream protection guidelines that have been developed for forest practices called ***Best Management Practices (BMPs)***. BMPs address such items as soil protection, drainage systems, and road maintenance. BMPs prescribe the most effective and practical means of preventing or reducing the amount of "***non-point source pollution***" generated by forest practices.

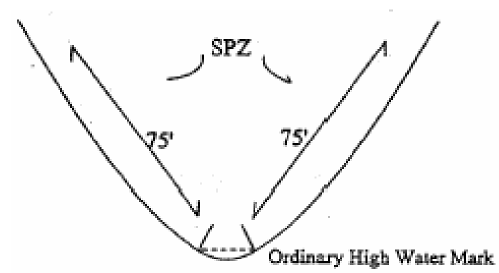
BMP Requirements & Streams:

For forest practice purposes, streams are divided into two categories: Class I and Class II. Each category has its own set of BMP requirements.

> ***Class I streams*** *are used for domestic water supply or are important for spawning, rearing, or migration of fish. Domestic water supply streams are considered Class I for a minimum of ¼ mile upstream from the point of domestic diversion.*
>
> ***Class II streams*** *are usually minor drainages or headwater streams that do not support fish and are not used for domestic water supply.*

<u>Class I Stream Protection Zone</u>

Class I streams have a ***Stream Protection Zone (SPZ)*** of ***75 feet*** on each side of the "***Ordinary High Water Mark***".

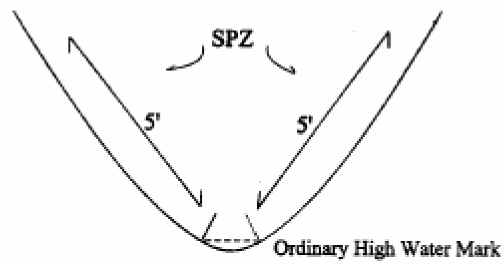


For example, one of the BMPs for Class I streams says that logging can occur inside the Class I stream protection zone (75 feet on either side), *but 75 percent of the current shade over the stream must be maintained*. Shade is important because it helps to maintain the cooler water temperatures needed by fish.

<u>Class II Stream Protection Zones</u>

Class II streams have a stream protection zone (SPZ) of **30 feet** on either side of the "Ordinary High Water Mark", wherever they may potentially impact a Class I stream. The most common example of this is where the Class II stream flows into a Class I stream.

In cases where a Class II stream would have no impact on a Class I stream, the SPZ would be only **5** feet (as illustrated below). This can occur if, for example, a Class II stream is intermittent, flowing on the surface and then going underground without flowing into a Class I stream.



A few other examples of other stream-related BMPs include:

1. When streams must be crossed, temporary structures must be installed that are adequate to carry stream flows. Skidding logs in or through streams is not permitted. This rule applies to both tracked or wheeled skidders.

2. Provide and maintain ***large organic debris*** (referred to as ***LOD***) along a stream. LOD is defined as large, living or dead trees and parts of trees that are buried in the stream bank or bed. LOD is important because it creates diverse fish habitat and stable stream channels by reducing water velocity, trapping stream gravel, and allowing scour pools and side channels to form.

BMPs & Soil Protection

To keep ***sediment*** (dirt) out of streams, the soil must be protected from erosion and other damage. To minimize soil erosion during logging, the harvesting method and the type of equipment used must be carefully chosen to suit the conditions of the site (such as slope, landscape, and soil properties).

Specific BMPs have been developed for all aspects of forest management including timber harvest, maintenance of productivity, road specifications and plans, road construction, road maintenance, minimum tree seedling stocking levels, use of chemicals, and slash management. These BMPs can be found in the Idaho Department of Lands publication Rules and Regulations Pertaining to the Idaho Forest Practices Act, Title 38, Chapter 13, Idaho Code.

The following are examples of BMPs that have been developed for tractor ***skidding*** and line skidding:

→ Tracked or wheeled skidders should not be used on geologically unstable, saturated, or easily compacted soils. (Unstable and erosive soils are generally the sands and silts. Clays, loams or soils high in organic matter tend to be less erosive.)

→ Line skidding is usually required on steep slopes, especially adjacent to Class I or Class II streams. Line skidding is required if the slope exceeds 45%.

In the end, the condition of our streams is a reflection of how well we are managing our natural resources. With the proper application of BMPs, our streams will be protected.

TREE HEALTH

Determining a tree's health is an important part of caring for a forest. Some tree health problems may be confined to an individual tree, but problems that occur on many trees within a forest may indicate an unhealthy forest. An understanding of the relationship between tree health and forest health is important in making management decisions because, to permanently improve forest health, a broad range of management actions over a long period of time is often necessary.

To assess the health of a tree, use a logical, three-step approach. Start by looking for abnormalities and damage. If anything is found, look for additional signs and symptoms, and then use all these clues to help you determine the type of damage, and finally, identify a specific causal agent.

A. Locate Any Damage

Look over the tree for damage such as scars, holes, discolored needles, missing bark, fine sawdust in bark crevices or around the base of the tree, unusual swellings or growths, or pitch flow. A very important clue is to stand back and look at the top of the tree. Is it dead, off-color, fading, or does it have an unusual crop of small cones? Compare the growth of the top leader to nearby trees of the same size and species to assess current growth. Short growth or other crown problems are evidence that the tree is not getting sufficient nutrients to maintain normal health.

Look for a pattern of damage. Does the damage involve the whole tree or only a certain side or height or age of needles? Be sure to check adjacent trees for similar problems. Is the damage only on a certain size of the tree? Are other species damaged, too? Also, look at the surrounding environment. Is the damage limited to depressions, ridge tops, southern exposures, etc.?

B. Determine the Type of Damage

There are five general causes of damage, including:

1. ***Insects*** – Insects can be identified by the presence of the insect itself or more often by its damage. Look for fine sawdust in bark crevices or around the tree base, small holes in the bark, grooves or tunnels under the bark or in the trunk of the tree, small masses of pitch (***"pitch tubes"***) on the trunk, and chewing or webbing on needles.

2. ***Diseases*** – Diseases are sometimes harder to identify than insects. Look for discoloration or browning of foliage, pitch flow or sap oozing from the bark, unusual growths, swellings, or decay, or the fruiting bodies of fungi called ***conks***.

3. ***Animals*** – Animals usually damage trees by chewing, rubbing or breaking branches, while birds peck holes in them.

4. ***Mechanical*** – Mechanical damage is the result of equipment in the forest. Look for torn or missing bark and broken or scraped branches.

5. ***Environmental*** – Environmental damage is the result of weather, fire, or chemicals in the environment. Look for damage across a broad area on many trees of different sizes and often on many different species including shrubs.

NOTE: Often trees are damaged by one of these five factors and are then attacked by insects or disease, which may mask the original cause of damage. It is also common to find multiple problems on the same tree, because an already weakened tree is more susceptible to insects and diseases.

C. Identifying the Specific Agent that Caused the Damage

<u>Insects</u> – Three major types of insects damage trees, including:

1. **Bark beetles** bore through the bark of trees where adults lay their eggs and larvae feed, grow and mature in the inner bark. This activity girdles the tree, which usually kills it, although some trees may survive if the attacks are limited (e.g. "***strip attacks***"). Each type of bark beetle has a distinctive egg gallery. Look for sawdust and/or pitch tubes in bark crevices or on the ground around the tree or galleries under the bark on the trunks of dead and dying trees. Sometimes only the tops of trees are killed.

2. **Defoliators** feed on the leaves or underside of needles. Some larvae mine buds and old needles of trees. After several years of severe defoliation, branches may die back, and top kill may occur. When defoliator populations are high, tree mortality can occur or trees can become susceptible to other insects or diseases. Look for chewed needles or leaves. Look for larvae, pupae, webbing and cocoons or egg masses.

3. **Wood Borers** infest weakened, dead, or recently felled trees. Wood borers can kill live trees (occasionally) when populations are high. The larvae mine first into the cambium of the trunk, branches or roots of the tree, then bore into the wood. Look for round or oval-shaped holes and tunnels through the wood. These may be either tightly packed with fine boring dust or loosely packed with coarse boring dust.

<u>Diseases</u> – There are five broad categories of diseases:

1. **Root Diseases** are caused by fungi that can be recognized by the distinctive decay or fruiting bodies they produce. Young trees of all species are attacked. Douglas-fir and grand fir remain highly susceptible for life but many species become less susceptible with age. Trees of all sizes can be attacked.

As root disease spreads through the root system, it slowly starves the tree (this usually takes several years for large trees). Root diseases generally spread from tree to tree via direct root contacts, which often results in a "***pocket***" or "***center***" of dead and dying trees.

Trees with root disease often have shortened terminal growth, with rounded crowns. They may also have thin, off-color (yellowish) crowns and a stress cone crop. Often, pitch will ooze through the bark at the base of the tree. Roots on ***windthrown*** trees may appear stubbed or callused over.

2. **Dwarf Mistletoes** are small parasitic plants that attack live trees. They produce small plants on infected branches that vary in size from one to several inches and may be yellow to purple to brown or olive green in color. Infections are most common in the lower portion of trees and often stimulate unusual branch growth, resulting in dense clusters of branches called "***witches brooms.***"

   Top kill or "***dieback***" is common as the nutrients are siphoned off by infections in the lower crown. Severe infections will reduce tree height and diameter growth. Trees are rarely killed but may be seriously deformed. Bark beetles sometimes attack trees weakened by dwarf mistletoe infections.

   Look for witches brooms, swelling on stems and branches, and small dwarf mistletoe plants in the branches.

> ***CONTEST TIP:*** Only Douglas-fir, western larch, ponderosa pine, and lodgepole pine are attacked by dwarf mistletoes in northern Idaho.

3. **Decays** are fungi that recycle wood. They are usually identified by the kind of decay they produce or by the fruiting bodies ("***conks***") produced on the trunk of infected trees. Most decays can be found on several different tree species, although some have a very narrow host range. They are extremely important in recycling dead and down trees, but some decays become a problem in live trees where they cause defect in work and weaknesses that predispose trees to failure. Trees with decay are used as nesting sites for many animal species, including birds, bats and many small mammals.

4. **Cankers** are caused by fungal diseases that attack the cambium layer and cause a deformity in the trunk or branches. Most canker-causing fungi occur on a very limited number of hosts. As cankers grow, they can girdle and kill trees or branches. Look for ***flagging*** (dead branches with brown or red needles on them), deformities in the trunk or branches, or areas of severe pitching.

5. **Foliage Blights** or **Needlecasts** are diseases caused by a group of fungi that attack the foliage of live trees. Most of these fungi are very ***host-specific*** (i.e. each fungus attacks only one kind of tree). They usually attack either the current season of foliage or older foliage, but not both, so trees are rarely killed. Most of these diseases are strongly favored by moist climatic conditions so some trees in a stand may be severely infected while adjacent trees have little or no infection due to minor differences in site conditions. Look for yellowing, browning or loss of foliage, especially in the lower crown where moisture conditions are generally more favorable for these fungi.

Animals

Animals cause various kinds of damage to trees, depending on the type of animal that caused the damage. For example, many browsing animals, such as deer or moose, will chew the top or branches off. Bears sometimes damage or even girdle cedar and larch trees by peeling off strips of bark to feed on the underlying cambium.

Woodpeckers flake bark off to reach insects underneath, but the birds cause little, if any, damage compared to the insects infesting the tree. Woodpeckers also excavate nesting holes in the boles of trees, but again, the “damage” is secondary to the decay that was already present.

Mechanical

Mechanical damage is man-caused: The use of equipment such as skidders, saws, trucks, etc. can cause bark injury, broken branches, broken tops and boles on small trees, scraped branches, and other injuries.

Environmental

Environmental damage includes snow or wind breakage, lightning, frost injury, winter desiccation, and drought. It can be difficult to distinguish environmental damage from other kinds of damage. Determining environmental damage will often amount to eliminating other possible causes of damage by the lack of symptoms (e.g. no cankers, no insects, no galleries, no decay, and no mechanical damage).

SILVICULTURE(1)

Silviculture, according to the Society of American Foresters dictionary, is "The art and science of controlling the establishment, growth, composition, health, and quality of forests and woodlands to meet diverse needs and values of landowners and society on a sustainable basis".

Foresters practice silviculture to improve tree growth, forest health, timber quality, economic return and other values over the long term. The primary silvicultural tool for managing forests is cutting trees, whether through a ***stand regeneration cut***, where trees are left for seed sources (or seedlings are planted afterward), or a ***thinning***, where trees are cut to make more room for the remaining trees. A thinning may be ***commercial***, where logs are taken to the mill, or "***precommercial***" where sapling trees are cut.

If silvicultural treatments are done properly, they can:

- Reduce insect, disease and other forest health problems
- Improve the genetic quality of natural regeneration
- Shorten the time until next harvest
- Produce higher value trees in the next harvest
- Improve wildlife habitat and other forest values

In planning a stand regeneration cut or thinning, people sometimes focus mainly on the dollar value of the trees removed. To plan for the future forest, the quality of trees left in the stand must be considered foremost. The choice of individual ***leave trees*** depends somewhat on the desired spacing and which species are best adapted to the site. However, many other factors must also be taken into consideration, including the following:

Forest Genetics

Choosing high quality leave trees is critical to the future health and quality of a forest stand. Foresters use three guiding principles to select the best quality leave trees:

1. Trees that will be structurally stronger and produce the highest quality of wood before the next harvest
2. Trees that will produce the most wood before the next harvest
3. Trees that will pass on desirable genetic characteristics to their offspring (naturally regenerating seedlings)

(1) Adapted from Leave Tree Selection, by Chris Schnepf, Area Extension Forester, University of Idaho Extension

Successive partial harvests made without considering leave tree quality often erode the genetic quality of forest trees.

Trees are distinguished by their ***genotype*** (their "DNA") and their ***phenotype*** (the combined expression of genotype and environment, which results in a tree's observable characteristics). It is often difficult to determine whether a tree's characteristics are due to genotype or environment. For example, a tree may have a forked top because of genetics or porcupines, or both.

We can only choose leave trees on the basis of what we can see – their phenotype. It doesn't necessarily matter whether the characteristics are primarily due to environment or to genotype. Even if a tree has poor characteristics due primarily to its environment, we would want cut it to create more space to allow the growth of adjacent superior trees to increase.

Tree Health

Many insects, diseases and animals can damage trees. Most are a natural part of the forest, at least to some degree, but sometimes these organisms damage more trees than we would like.

Unfortunately, we have often inadvertently created a favorable environment for these damaging organisms to increase in population beyond normal levels. For example, forest fire exclusion is one of the primary underlying causes of forest insect and disease epidemics. This is because ground fires tended to kill the understory tree species that are susceptible to these damaging organisms. Stand replacing fires also helped regenerate species that were more resistant to insects and disease.

Removing trees with evidence of insect or disease damage can sometimes help to "disinfect" a forest by reducing the abundance of the detrimental organism (such as dwarf mistletoe). Even if harvesting is unlikely to reduce infection or infestation, removing damaged trees creates more growing space for the healthier, more desirable trees. Also, since we are leaving trees which were not as affected by damaging organisms, we may be promoting genetically inherited pest resistance.

EXAMPLE - Remove trees with:
- Witches brooms from dwarf mistletoe
- Conks, seams and other evidence of stem decay fungi
- Tops broken by porcupines, wind or other causes
- Excessive bark scarring or other mechanical damage
- Thin crowns, flat tops or other indicators of poor growth and vigor

Growth Rate

Leaving high quality trees provides the best growth rates and quality (and, therefore, stronger trees and higher value timber) before the next harvest. These trees will also pass on their desirable *inherited* characteristics to their seedling offspring.

To pick the most robust leave trees, you should favor trees with:

40-60% crown ratio – The crown ratio is the portion of the tree with living branches. A 50% crown ratio means that fifty percent of the tree's total height has living branches coming from it. Trees with smaller crowns are less able to take advantage of the growing space provided in thinnings.

Healthy foliage – Leave trees should have abundant needles with good color in their needles.

Long leader or internodes – Every year, pines and fir grow a new set of horizontal branches called a ***whorl***. The places these branches emanate from are called ***nodes***, and the distance between them is referred to an ***internode***. An internode usually represents one year of height growth. Longer internodes indicate better height growth.

Pointy tops – If you can see the top of the tree, is it "pointy" or rounded in shape? Trees with pointy tops are generally more actively growing in height. As a conifer gets older, height growth slows and the top becomes rounded or flat.

Bark characteristics – Tree diameter does not necessarily indicate age. A small diameter tree with bark that looks like one of its 100+ year old cousins is likely to be a slow-growing tree. For example, old ponderosa pine bark is platy and yellow, while younger ponderosa bark tends to be black.

Growth Quality

Favoring trees with better form promotes a higher return for the next harvest, because logs will have more merchantable volume. These trees also pass on these characteristics (to the degree that they were inherited) to the new tree seedlings (their offspring).

Favor trees with the following growth form characteristics (2):

BRANCHES	BOLE (TRUNK)
Medium sized	Straight
Not too dense (broomed) or thin crown	No forks
Not too heavy branching (e.g. open grown)	No crook
No ramicorn branching	No sweep
No sharp branch angles	No major doglegs

(2) **Adapted from <u>Plus Tree Selection Guidelines</u>, provided by Lauren Fins, Inland Empire Tree Improvement Cooperative**

<u>Instructor's Guide:</u> PRACTICING SILIVICULTURE for the FORESTRY CONTEST

Foresters use an almost artistic weighing of all the criteria given above when choosing leave trees. They make thousands of side-by-side comparisons between adjacent trees to decide which trees best satisfy the most critical criteria for the site.

It is highly recommended that you use the booklet <u>Logging Selectively</u> by Chris Schnepf as a supplemental reference for this section of the contest manual. A companion video titled "I want to log selectively" is also available for checkout from UI Extension Offices, IDL Offices, or purchase from the University of Idaho Educational Communications.

The following exercise provides contestants an opportunity to evaluate and rate four trees of varying quality (based *only* on form). The instructor should choose and flag out sets of four trees that:

- *Can all be seen from one spot*

- *Are all the same species*
  For advanced groups, you could choose different species to integrate species site adaptation into this exercise. However, at first it is necessary to limit some criteria to help participants focus on individual tree characteristics, rather than site or stand characteristics.

- *Are all the same age class*
  The purpose of limiting practice to even-aged stands is to help contestants to focus on individual characteristics of trees that have been competing in an even-aged stand. Most forest stands in Idaho are even-aged, from regeneration after fires. Later, to promote discussion in advanced groups, you could select stands with multiple age-classes and talk about the relative ability of different species to "release", given their silvics and the site, etc. [**Note:** We never get to this level in the forestry contest]

- *Provide a diversity of individual tree characteristics to consider* based on all the criteria discussed in this chapter. Try to include a range of tree quality. Consider flagging a number of different sets of trees to allow for practice on specific characteristics, especially those that may be difficult to understand. For example, one set could be composed of relatively equal, high quality trees except for degree of sweep or some other individual characteristic.

Have the participants rank the four trees in a set, then lead a discussion about why some trees are better than others.

NOXIOUS WEEDS

A **noxious weed** is defined by the Idaho State Department of Idaho as any plant that may create a "public hazard" or "serious economic loss" to agriculture and the people of Idaho.

Noxious weeds are almost always plants that have been introduced (either accidentally or purposely) into areas where they were not originally found. Since noxious weeds are not native to these areas, there are few natural controls present, and so they tend to spread rapidly, crowd out native plants, and be very difficult to control.

NOXIOUS WEED CONTROL

Developing a basic weed control strategy begins with:

1. *Identifying the weed*

2. *Determining what makes it a problem. For example:*

   Toxicity to Humans and Livestock is one of the most common problems. Poisonous plants can cause loss of life, serious health problems, and costly animal care services. Toxic weeds in feeds are an animal's nightmare.

   Allelopathy: Some noxious weeds produce chemicals that inhibit growth or even kill adjacent plants. Weeds with this ability are said to be ***allelopathic***.

3. *Determining why it's hard to control. The reasons can include:*

   → **Life Cycle** – It's important to know whether the weed is ***perennial***, ***biennial*** or ***annual***. A perennial weed is likely to be the most difficult and costly to manage. Biennial and annual weeds have a shorter life, making them vulnerable to more control options than perennials.

   → **Ability to Reproduce and Spread** by seeds, rhizomes, roots or other parts. The quantity of seeds produced annually per plant and the life of those seeds in the environment are very important factors. Weeds that produce hundreds or thousands of seeds per plant each year create the need for years of expensive management. Some weeds produce a few seeds that may survive in the environment for 60 years or more, making it nearly impossible to totally eliminate them.

   Some perennial weeds can sprout from cut-up plant parts, so cultivating, mowing or pulling can actually increase their populations and rate of spread. Cutting or burning some weeds stimulates the roots to sprout more seed producing stalks.

CONTROL METHODS

All of the factors listed above must be considered when developing a management plan for weed control. In addition, we must keep in mind that each plant species will express its own particular characteristics in relation to its environment. Much like people, the reactions of individual plants of a single species will vary under various conditions. Thus, depending on climate or other variations in growing conditions, the same weeds often must be managed in different ways in different areas.

A good weed control plan involves using more than one strategy and more than one control method. The control methods selected must be affordable while preserving or helping to create the desired environment. The most common methods for weed control include:

→ **Cultural and organic control methods** such as fertilization, irrigation and planting crops to compete with the weeds

→ **Mechanical control methods** such as tilling, hoeing, pulling, mowing, burning, or mulching

→ **Biological control methods** such as insect or plant pathogens and livestock grazing

→ **Chemical control methods** involving herbicides

→ **Non-biological control methods** such as boiling water, vinegar or lemon juice

CONTEST TIP - At the Forestry Contest, you will be expected to be able to:

1) **Identify the 13 weeds listed on the chart (see next page) and their impact on people, animals and/or the environment**

2) **Define the term "noxious weed"**

3) **Know the 5 common types of control methods and give examples of each type**

4) **Know the best control methods for each weed**

NOXIOUS WEEDS TO KNOW

The following chart lists 13 of Idaho's 36 noxious weeds. More information about these noxious weeds, their effects and their control can be found in the "Regional Noxious Weeds" booklet, published by the Selkirk Cooperative Weed Management Area, a weed control organization based in northern Idaho. Copies of this publication can be obtained from the Idaho Department of Lands (local area offices or the IDL Forestry Assistance office in Coeur d'Alene), the U.S. Forest Service IPNF offices in Coeur d'Alene or Sandpoint, or the Boundary and Bonner County weed supervisors.

IDAHO NOXIOUS WEEDS

Weed Name	Life Cycle	Toxic To	Economical Threat	Primary Control Problems
Hawkweeds	P	N	rapid spread	A, C, D
Leafy Spurge	P	H, L	resists herbicides	B, C
Poison Hemlock	P	H, L	medical bills & death	B, C
Purple Loosestrife	P	L	plugs waterways	A, B, C
Scotch Broom	P	L	long-term seed life	B, C
Knapweeds	B & P	L, P	rapid spread	A, C, D
Yellow Star Thistle	A	L	rapid spread	A
Canada Thistle	P	N	rapid spread	A, C, D
Dalmation Toadflax	P	L	resists herbicides	B, C
Yellow Toadflax	P	L	resists herbicides	B, C
Rush Skeletonweed	P	N	resists herbicides	A, D
St. Johnswort	P	H, L	resists herbicides	B, C

Life Cycle	P = perennial; B = Biennial; A = Annual
Toxic To	L = livestock; H = humans; P = other plants; N = not
Economical Threat	Why it costs so much to control; resists herbicides means few choices of chemicals & very costly to use
Control Problems	A = mass seed production; B = seed life exceeds 15 years; C = plant parts & cut roots regrow;
	D = wind carries seed.

APPENDIX A

One of the objectives of the Idaho State Forestry Contest is to provide opportunities for students to meet with and learn from professional foresters and other natural resource management professionals. Often, these people are very willing to help a team prepare and train for the contest.

The nearest offices of the Idaho Department of Lands, the Natural Resources Conservation Service, the Cooperative Extension Office, and the United States Forest Service Ranger Districts are all excellent sources of assistance. IDL Forest Practice Advisors, District Conservationists, and Extension Agents are often happy to volunteer some of their time to help out. Foresters who work with local forest products industries are another possible source of assistance. Help is readily available -- so don't hesitate to call.

BOOKS, PUBLICATIONS AND RELATED RESOURCES

Ranger Model Compass – Instruction Manual Silva, Inc., Highway 39 North, LaPorte, IN 46350

Be Expert With Map and Compass Bjorn Kjellstrom

Logging Selectively by Chris Schnepf; Pacific Northwest Extension Publication – PNW 534

Regional Noxious Weeds – What they are…How to kill them – Selkirk Cooperative Weed Management Area, Published by Spud Press Printing, 2004 Sandpoint and Bonners Ferry, ID.
Phone: 208-263-9179

Forestry Supplies Inc. Catalog
P.O. Box 83847, Jackson, MS 39284-8397
Phone: 800-647-5368
Website: www.forestry-suppliers.com

Ben Meadows Company Inc. Catalog
P.O. Box 5277, Janesville, WI 53547-5277
Phone: 800-241-6401
Website: www.benmeadows.com

TerraTech, Inc.
P.O. Box 5547, Eugene, OR 97405-0547
Phone: 800-321-1037
Website: www.terratech.net

Many publications and videos are available through local Cooperative Extension offices from University of Idaho (UI), Oregon State University (OSU), and Washington State University (WSU). These publications include:

- Terminology For Forest Landowners (WSU) – EB 1353
- Measuring Timber Products Harvested From Your Woodland (OSU) –EC 1127
- Tools for Measuring Your Forest (OSU) – EC 1129
- Measuring Trees – PNW 31
- How to Plan, Plant, and Care for Windbreak, Reforestation, and Conservation Plantings (UI) - MISC 13
- Diameter Limit Cutting: A Questionable Practice (UI) CIS 654
- Thinning: An Important Management Tool – PNW 184
- Logging Selectively – PNW 534
- Soil and Water Conservation: An Introduction for Woodland Owners (OSU) –EC 1143
- Compaction of Forest Soils – PNW 217
- Idaho Forestry BMPs: Forest Stewardship Guidelines for Water Quality (UI) – EXT 745
- Forest Water Quality (UI) – video

Copies of these publications also may be ordered through the following university publication offices:

Ag Publications Building
Building J40, Idaho St.
University of Idaho
Moscow, ID 83843-4196
(208) 885-7082

Bulletin Office
Cooperative Extension
Cooper Publications Building
Washington State University
Pullman, WA 99164-5912
(509) 335-2857

Agricultural Communications
Oregon State University
Administrative Services A422
Corvallis, OR 97331-2119
(503) 737-2513